THE ENGINEERING AND MINING JOURNAL.

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NOTE.—Communications relative to the editorial management should be addressed to Mr. ROTHWELL. The articles written by Mr. Raymond will be signed with a star.

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AMERICAN INSTITUTE OF MINING ENGINEERS.

OFFICIAL BULLETIN.

THE October Meeting of the Institute will be held in Philadelphia, beginning Tuesday evening, October 24th, in the hall of the Franklin Institute, Seventh Street, below Market. The Council has decided to have no excursions during this meeting, that the members in attendance may have the opportunity to visit the International Exhibition. Members are earnestly requested to give early notice to the Secretary of the titles of papers to be read. Blank proposals for membership of the Institute can be obtained from the Secretary.

Authors of papers read before the Institute are entitled to twelve copies of the ENGINEERING AND MINING JOURNAL containing their papers. These copies will be sent on application to the Office of the JOURNAL, or the Secretary of the Institute, immediately after the appearance of the papers. Back numbers cannot always be supplied.

EASTON, Pa., Oct. 2, 1876. THOMAS M. DROWN, Secretary.

THE MEETING OF THE INSTITUTE OF MINING ENGINEERS.

THE attractions of the Centennial, added to those which always characterize the meetings of the Institute, insure a large attendance of mining engineers in Philadelphia, on the 24th inst. Several valuable papers are announced, and a number of distinguished foreign engineers and metallurgists will take part in the discussions. Those who have not already announced to the Secretary the titles of their papers, should do so at once, and we would urge upon the members the importance of placing upon record, in the form of papers to the Institute, the difficulties that beset them in their practice, and the manner in which they have overcome them. The Institute has for its chief object the interchange of professional experience, and each member should feel it a personal duty to contribute to the general fund from his own practice, even though the matter may, from familiarity, appear to him to be of but little general interest.

THE BUSINESS OUTLOOK.

As the watch on deck reports, at stated intervals throughout the night, the condition of the weather, so it becomes us, who are the watch on deck of certain very important industries, to review, from time to time, the condition of trade and the business outlook for the future. For three years past we have had but a dismal and thankless task to perform, but, as our readers know, we have not hesitated to tell the disagreeable truth in preference to prophesying pleasant things and pleasing all by foretelling what all desire, rather than what we see is coming. We were never of those who looked upon the great business depression, which has obtained since 1873, as the result simply of "want of confidence," and who believed that if every one would only convince his neighbor and himself that all that is required to bring back "the good old times" is to believe they are about to begin, and buy and sell on that supposition, business would immediately revive and prices increase to the old time figures. It is now needless to say that the various papers that periodically preached this doctrine were but blind leaders of the blind, and led their followers deeper into the slough of despond, through which so many have had to pick their uncertain steps for some time past.

The trouble in business was due to no mysterious cause; it was simply the result—the natural and oft-recurring result—of over trading. Business moves in cycles. "Good times" mean the upward period, when values of all kinds are increasing, and shrewd business men and speculators taking advantage of it and trading far beyond their means, grow rich rapidly and easily. As these cases become more numerous and better known, the spirit of speculation takes hold of the great mass of the people, and all classes, in their effort to grow rich suddenly, buy far beyond their means, counting on a continuance of the upward movement to enable them to pay for their purchases. The whole country becomes swamped in debt through this overtrading, when, finally, a financial "panic" is precipitated by the failure of some large speculator (individual or company), and the purchasing mania is checked. Since the business done was largely speculative—whether it was buying coal lands that were not wanted, or building railroads that were not called for—the reaction that sets in is severe and protracted, just in proportion as the upward movement was long continued and the values attained were high.

Since 1873 this country has been passing through the downward phase of business, and the question now is, has it reached the bottom, and if so, when will the next upward movement commence? It is evident that the conditions which affect each industry, must be considered separately, for, in some overtrading has been carried much further, and their recovery will be slower than in others. We shall confine our remarks chiefly to those industries in which our readers are principally interested.

In the iron trade, taken as a whole, we believe the tide has ceased to ebb, and in the West and South has commenced to flow. In the anthracite iron trade the outlook is not nearly so bright, for that branch of trade was greatly overdone, and the comparatively high price of fuel and freights during the past three years have materially aided in transferring to the Western works much of the business, for the supply of which the Eastern furnaces were built. Several of the furnaces have also continued to make largely from high-priced stock, and are now loaded down, as are also some of their friends, with large quantities of iron. There can be no question but that the demand for iron has considerably increased, even here, during the past few months, and it will continue to increase; but the large number of furnaces standing idle, the reductions in the price of fuel, freights, and other items of cost, and the financial necessity of several holders of large stocks, makes it quite apparent that no increase in price can be looked for, though it may be talked about, and even attempted in spurts. On the contrary, we will not be surprised to see somewhat lower prices than have yet ruled, accepted between the present time, and, say, the 1st of April next. We hope to see more energetic efforts made to secure a foreign outlet for our surplus, for with furnaces here in the East, which have a capacity greatly in excess of our home demand, and no foreign market, it seems simply impossible that prices can rise for years much above cost at the majority of the best works. There is no room for anticipations of prices which will leave any profits, except upon the strictest system of economy in the management of the works, and we would impress upon our ironmasters that a liberal infusion of science into the management, is one of the essential features of "strict economy."

In the coal trade, throughout the whole country, the outlook is far from discouraging. Production in the West, generally, is increasing, and the coal trade is quite prosperous, though prices obtained are low, and will, doubtless, continue so. In the East there are many disturbing elements to be taken into account.

Since the rupture of the great Anthracite Coal Combination, prices have ruled very low—even below the actual cost of coal delivered in the market—yet it is easy to see that needy operators will prefer to continue working their mines to their utmost capacity just so long as the loss on coal produced is less than the loss incurred in standing idle, and especially will this be the case, when the coal coming forward enables them to tide over those "dead points" of maturing notes which could not be met were they to stop producing. These remarks are not confined to small operators, but cover so large a proportion of the coal mined, that there is very prosepect of the production continuing in excess of the requirements, and prices remaining quite low till such time as the general business of the country—which is certainly improving—shall require a larger quantity of fuel.

In the Eastern bituminous trade the prospects are for exceedingly low prices for some time to come, but to those who, by the exercise of economy and the enlightened co-operation of the transportation companies, are able to hold out, there is the prospect of a full reward in the future. The coal trade of the country is already an enormous interest, involving the employment of many hundreds of millions of dollars, and the first indication of returning prosperity in general business is immediately reflected in an increasing demand for coal. The presence of combinations, such as that we recently had in the anthracite trade, disturbs the indications and destroys the sensitiveness of this great trade barometer, but, nevertheless, the general movement of coal is the most reliable criterion that can be found by which to measure the business activity of the country, and our reports from all parts of the country, recording as they do the production of increasing quantities of bituminous coal, are very encouraging. We do not look for high prices in anything for some time to come, yet the business outlook is not without much encouragement for a healthy business and a bright future. At the same time we fear that there is still a storm brewing, which will cause much uneasiness before the sky finally clears away for the coming prosperity in the coal and iron trades in the East.

We note in our exchanges the improvement in the cotton manufacturing interests, and after the excitement of the presidential election shall have subsided, and politics cease to occupy so great a share of the public attention, we look for a still more marked improvement in almost all kinds of business. It is to be hoped that the principles of science and economy, which we have been advocating for the coal and iron trades, will be introduced into the business of the nation where they are just as necessary and as much called for as in the management of a blast furnace.

THE BEST FIELD FOR INVESTMENT OF CAPITAL.

A LARGE part of the capital of the country has laid almost useless for two or three years past, owing to the collapse of the favorite investments. Imprudent capitalists discovered too late that railroads built from nowhere to nowhere in the wilderness were simply sinking funds for the absorption of money, and could not, for very many years, if at all, pay the interest on their cost, and that furnaces, built with the chief object of "improving" somebody's property by enabling him to sell town lots, and where the profits were estimated on the basis of war prices for iron, were but a delusion and a snare. The reaction has lasted long, and as men become tired of holding their money unproductive and not over safe in banks, they begin to look about for new and profitable fields for investment. The enormous profits made in mining are again attracting attention, and we see very clear indications of returning interest in this class of investment. We welcome this returning tide, and shall endeavor to give such information as will enable those who desire to use their capital in the most profitable industry the country possesses, to avoid the quicksands and shoals which surround this, as they do every other extra profitable field for investment. In no other business can capital be so profitably employed as in mining; but it is also true that in no other business is deception so easy, and in none do capitalists act with so little prudence or care. They too often seem to become blinded by the glamour of fabulous dividends, and they accept the wildest assertions of interested enthusiasts, or dishonest speculators, as the grounds for investment. Yet, when they find these statements have no more solid foundation than the "baseless fabric of a vision," they condemn mining, and not their own imprudence, as the cause of their losses. If capitalists will "hasten slowly" to invest their money, and closely examine, by the help of competent and honest experts, what they propose purchasing *before*, and not *after*, their investments, they will rarely have cause to deplore losses in this field. There are too many good properties to make it necessary to pay out money for mines without the utmost care in preliminary investigations.

The American Mining Stock Board of this City, in offering greatly increased facilities for dealing in mining securities, will contribute to, as it has been itself the outgrowth of, this increasing interest in mining investments.

Since many of those who may be disposed to venture into mining stock speculations are comparatively ignorant of the value of what they purchase, we repeat again the words of warning we have so often addressed to them.

The value of a mine is generally estimated as but little more than the value of the ore actually in sight, and an undeveloped property, even if it be on the continuation of the great Comstock Vein itself, and, possibly, near a bonanza mine, has not, necessarily, any value whatever; nor is it sufficient that a mining company has a capital stock of $10,000,000, or any other number of millions of dollars, to make its shares worth a few per cent., or a fraction of one per cent. of par.

It should be borne in mind that while the Mining Stock Board may become an undoubted benefit from the facility which it offers for persons of moderate means to invest in mining stocks, it by no means guarantees the soundness of the concerns whose stock it calls, and from the very facilities it offers it makes it all the more necessary that investors should carefully investigate for themselves the actual value of the mines in whose securities they propose to invest. We believe the officers of the New Board will gladly co-operate, so far as they may be able, in every effort which has for its object to make mining investments profitable, and to prevent deception, whether it be willful or through ignorance, which would endanger capital.

A BLAST FURNACE ZINC PROCESS.

THE interesting paper of Mr. F. L. CLERC, read at the Philadelphia meeting of the Institute, and published this week in our columns, opens a prospect of great importance in the metallurgy of zinc. Concerning the essential preliminary question (always to be asked with regard to an invention), whether an improvement of this kind is seriously demanded, there can be, in the present case, no manner of doubt. The invention of a continuous process, whether as the shaft-furnace or the reverberatory, for the production of zinc, would bring about a great economy. Many attempts have been made by the best metallurgists to effect this result; and several times it has been joyfully declared a *fait accompli*. But every enterprise of the kind thus far has ended in disappointment; and a strong presumption is thus established against the probability of success in each new experiment. It is against this presumption that Mr. CLERC argues, by explaining the nature and causes of the difficulties heretofore encountered, and the counteracting devices which he employs.

We confess that his reasoning appears to us sound, and that his plan promises better than any which we have seen described. Of course, unforeseen difficulties in construction and practical operation may arise; but if two points are satisfactorily proved, all the rest, we think, may be overcome with patience. These two points are: the establishment of a sufficiently high temperature in the charge and gases, together with its complete regulation in the condenser; and the successful prevention, by the means proposed, of the formation of carbonic acid where it will oxidize the vapors of zinc. Mr. CLERC's experiments render it probable that he can meet these points effectively. His calorimetric calculations, which might give us theoretical satisfaction on the former head, he does not communicate in full. But the ease with which high temperatures can be maintained in the iron blast-furnace leads us to anticipate no special difficulty in that matter.

We are glad to know that a working trial will soon be made of this process, on a scale sufficient to demonstrate its practicability beyond doubt. The prize at stake is enormous, amounting to hundreds of thousands of dollars annually on the zinc production of this country alone—a handsome percentage of which will fall to the share of the successful pioneer in this line. Mr. CLERC's practical familiarity, as chemist of the Lehigh Zinc Co., with the present process, its difficulties and losses, offers some security that his ideas will not prove wild and chimerical, as is so often the case with the brilliant visions of inventors who rush in where experts fear to tread. *

PROJECT FOR THE ERECTION OF BLAST FURNACES IN NEW JERSEY.

By William Kent, M.E.

(*Continued from page 237.*)

HOT AIR PIPES AND TUYERE NOZZLES.

THE pipe leading the hot air from the ovens to the tuyeres is made of wrought iron lined with fire-brick, this being considered better than a pipe with outside felting, as the latter is apt to give trouble and require frequent repairs. The size is found from OSBORN'S rule, before quoted, which may be expressed by the formula $D=\sqrt{\frac{Q}{10}}$ where D is the diameter of the pipe in inches and Q the cubic feet of air per minute. A pipe of 36 inches diameter is thus found to be amply sufficient.

Before reaching the tuyeres, the blast pipe is supplied with a TAWS & HARTMAN drop safety valve. It consists of a cast iron pipe with an opening in its upper side closed by a large cover, which is nicely hinged and fitted to a flange in such a manner that when the blast is on the furnace the cover is pressed against the flange by the pressure of the blast, and the valve offers an unobstructed passage to the tuyeres. The instant the blast is stopped the cover falls down against another flange, and tightly closes the blast passage, at the same time opening the upper part of the valve and allowing the escape to the open air of any gases which may find their way from the hearth of the furnace. A valve of this description is used at the Durham and Secaucus Furnace.

The circle pipe, which distributes the blast to the tuyeres, is hung from the mantle of the furnace, inside of the cast iron pillars. It is made of wrought iron lined with fire brick, like the main hot blast pipe.

There are five tuyeres, this being the number used at the most recent furnace. A larger number have been used, some of the Lehigh Valley furnaces having as many as nine, but it is now admitted that five are sufficient. The size of the tuyere nozzles varies at different furnaces from 2½ to 6 inches. The proper size is usually determined by experiment, and the nozzles are sometimes changed from one size to another.

PERCY gives the following rule for calculating the size of the tuyeres: "Let a=aggregate area of nozzles, and v the velocity of air in feet per second passing out by them; then the quantity of air escaping per minute will be $Q=60\,a\,v$. But, by the rules of pneumatics, if S = the weight of a cubic foot of air, p its pressure (in pounds per square foot) above the atmosphere, and m the co-efficient of reduction of the orifice (which we may take for conical tubes), at 0·94 we have $v = m\sqrt{\frac{2gp}{S}}$, whence $Q = 60\,am\sqrt{\frac{2gp}{S}}$."

This rule, however, is manifestly incorrect, since it assumes that the air issues through the tuyeres *into air at atmospheric pressure*, whereas it really issues into the furnace against a pressure probably much greater than that of the atmosphere, but how much no experiments have yet determined, and it is wholly a matter of conjecture. The formula would be correct if p represented, instead of the pressure of the blast above the atmosphere, the pressure above that in the furnace, or if $\frac{p}{s}$ represented what is known as the "difference of head," upon which the velocity depends.

The formula would give for the required diameter of the nozzles about 2·3 inches, but it will be better to make them 4 inches, and increase or diminish them if found advisable after the furnace is in blast.

BOILERS.

The amount of steam required for each engine is found from the size of the steam cylinder, the pressure, and the number of revolutions.

The cylinder is 50 inches in diameter and 7 feet stroke, making 16 revolutions per minute, and cutting off at ⅜ stroke. The volume of steam required per minute is $\frac{50^2\times.7854}{144}\times 7\times 2\times 16\times\frac{3}{8}=2670$ cubic feet.

We have seen that 30 pounds mean pressure above that in the condenser is more than sufficient for the requirements of the engine. It will be safe, therefore, to assume an absolute initial pressure of 35 pounds, or 20·3 pounds above the atmosphere, which will include all necessary allowances for back pressure and probable loss by condensation in the steam passages.

The weight of steam at 35 pounds absolute pressure, being ·08749 pounds per cubic foot, the weight required is therefore 2670×·08749=233·598 pounds per minute, or 14,015·90 pounds per hour. If we add 10 per cent. for priming and amount required for the pumps, the boilers will be required to evaporate 15,417·49 pounds of water per hour.

The rate of evaporation of plain cylindrical boilers per square foot of heating surface, according to TROWBRIDGE, is about 6·4 pounds of water per hour, estimating the heating surface to be only the lower half of the cylinder. These figures are for boilers using coal for fuel. The conditions of boilers using the waste gases as fuel are essentially different, as the initial temperature of the heated gases of combustion is much lower than where coal is used, and there is no radiation of heat from incandescent carbon as in ordinary boilers.

The writer has not been able to find any published statement of the rate of evaporation of boilers at blast furnaces, and it seems probable that a scientific "evaporation test" of a boiler using waste gas fuel has never been made. Using the figures above given for boilers which use coal as fuel, viz., 6·4 pounds per square foot of heating surface per hour, they would show the required heating surface to be 15,417·49÷6·4=2,409 square feet. This figure is very much smaller than is used in recently built furnaces, and it would be unsafe to follow it. The design must therefore be made in concordance with present practice, although such practice is scarcely worthy of a better name than "guess work."

The following are the number and dimensions of the boilers in use at some furnaces of recent date :

Allentown Furnace, No. 5.—60 feet high by 17 feet bosh. 4 boilers, each 50 feet long, 42 inches diameter, with 32 mud drums, each 50 feet long, 27 inches diameter. Estimated heating surface, including all cylindrical surface of the mud drums, and one-half that of the boilers, 2,800 square feet.

Franklin Furnace, N. J.—67 feet high, 23 feet bosh. 6 boilers, each 70 feet long, 40 inches diameter, with 6 mud drums, each 55 feet long, 36 inches diameter. Estimated heating surface, 5,300 square feet.

Durham Furnace, Pa.—76 feet high, 19 feet bosh. Designed for a production of 450 tons per week. 12 boilers, each 60 feet long, 36 inches diameter, and 12 mud drums, each 40 feet long, and 30 inches diameter. Heating surface, 7,200 square feet.

The boilers designed for the proposed furnaces are nine in number for each furnace, with a mud drum under each, as is the usual custom. The boilers are each 50 feet long, 42 inches in diameter, and the mud drums, each 40 feet long, 30 inches diameter. Heating surface, 5,300 square feet. This type of boiler is almost universally used at the anthracite blast furnaces. It has the advantages of simple construction, small first cost, and great durability, and requires but little attendance.

The mud drums are hung 12 inches below the main boilers, each by 4 connections, 12 inches in diameter. The boilers are arranged in sets or nests, containing three boilers with their mud drums in each, and each set is inclosed in a brick boiler house, lined throughout with common fire-brick. As the two furnaces have thus six separate boiler houses, one set may be thrown out of use at any time for cleaning or repairs, as only one-sixth of the total heating surface is thus lost, and there is sufficient surplus to allow of this without damage to the furnace. A steam drum 12 feet long, and 15 inches diameter is attached to each nest of boilers, near the end at which the waste gas enters, by short connections 12 inches in diameter. Short steam pipes, 5 inches in diameter, carry the steam from each steam drum to the 12-inch main steam pipe, which leads to the engine. The feed pipes enter the boiler at the end remote from the steam drum. Each boiler is provided with safety valve, water gauge and water cocks.

A fire grate is attached to each nest of boilers, near the waste gas entrance, so that coal may be used in case of emergency. If the coal be supposed to be burnt at the rate of 15 pounds per square foot of grate per hour, and each pound of coal to evaporate 7 pounds of water, the grate surface will be $\frac{15417}{15\times7}=$ 146·8 square feet, or 48·9 square feet for each nest. This requiring is fulfilled by making two grates in each nest, a small partition wall being built between the two, each 4 feet 1 inch wide, by 6 feet long. When not in use the grate bars may be covered with a layer of fire brick, to protect them from the heat of the combustion of the waste gases. The mud drums are made 10 feet shorter than the boilers, in order to give space for the grates.

The waste gases enter the boiler houses by the flue at the end of the fire grate, and pass thence over the grates and under the boilers and mud drums to the exit flue at the remote end, which connects the three nests belonging to each furnace with a common chimney. The chimney is 90 feet high and 4 feet in external diameter, lined 50 feet high with 4 inches of fire brick.

Considerable difference of opinion exists in regard to the comparative merits of brick and iron chimneys, but in most of the Lehigh Valley furnaces iron chimneys are employed, and they are for this reason included in the present design. Air is admitted to the boilers as to the ovens by TAWS & HARTMAN regulators.

DESCENDING GAS FLUE.

The flue which conveys the waste gases from the mouth of the furnace to the boilers and ovens is made of sheet iron, lined with fire-brick. The capacity of this flue should be sufficient to carry all the gases with such a velocity that there shall be no appreciable resistance by friction. It will be an error to make this flue too large, as the increased radiating surface and slower velocity of the gas will both operate to cause a loss of heat, unless it is well protected by lining.

According to the calculations already made, when 48·22 per cent. ores are used, the gases weigh 975·03 pounds for every 100 pounds of pig iron produced. At the assumed production of 300 tons per week, or 66⅔ pounds per minute, the weight of gas per minute will be 650·02 pounds. Assuming them to be at a temperature of 500° F., and of the same density as air of like temperature, we have for their volumes $\frac{650\cdot02}{\cdot08073}\times\frac{461\cdot2+500^\circ}{493\cdot2}=15{,}622$ cubic feet.

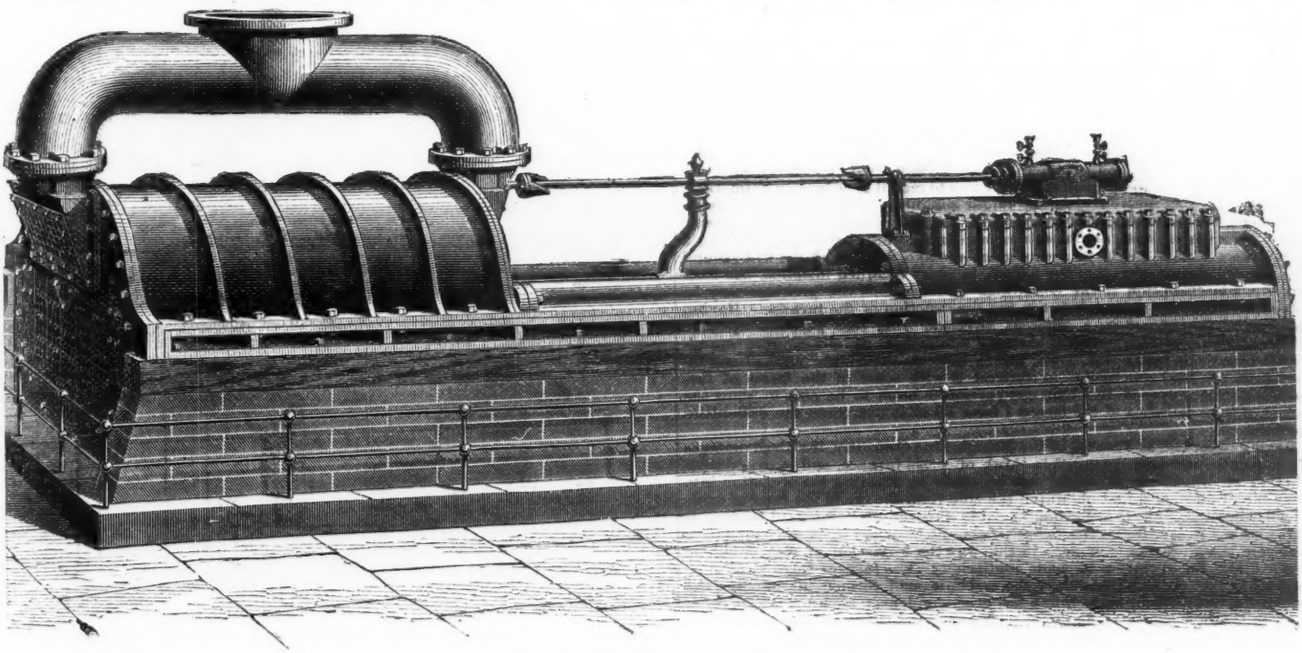
Applying the formula derived from the rule given by OSBORN, before quoted, $D=\sqrt{\frac{Q}{10}}$, it would appear that the waste gas pipe requires an internal diameter of 39¼ inches. This size is largely exceeded in many new furnaces, some having a pipe of 6 feet diameter. At Durham, the pipe is 5 feet, and that size is adopted in the present design. The fire-brick lining is 4½ inches thick, which reduces the internal diameter to 4 feet 3 inches.

TO BE CONCLUDED IN OUR NEXT.

THE KNOWLES BLOWING ENGINE AT THE PHILADELPHIA EXHIBITION.

Special Correspondence of the Engineering and Mining Journal.

THE blowing engine, exhibited by the KNOWLES PUMP COMPANY, has been designed by them on the same principle as that which they employ in making their pumps—and with the exception of having an air cylinder substituted for a water cylinder, it is identical with them in construction.



THE KNOWLES BLOWING ENGINE.

The steam cylinder is 18 inches, and the air cylinder 48 inches, in diameter. The stroke is 48 inches. Five clack valves at each end of the cylinder serve to admit the air. Two similar engines, having steam cylinders of 38 inches diameter and 10 feet stroke, with air cylinder 84 inches in diameter, have been used for the last six years. They run at from 10 to 11 strokes per minute, which speed can be increased to 16 strokes with the air at a pressure of 4½ to 5½ lb. per square inch. The merit which these direct acting blowing engines without fly wheels possess lies chiefly in their cheapness, as steam cannot be so economically used in them as in engines which work expansively. The saving in cost of foundations and general simplicity has given the preference, quite generally, to direct-acting horizontal engines, both for pumps and blowing engines, and of this class the KNOWLES engines stand deservedly high in public estimation. The illustration above shows clearly the general arrangement of one of these blowing engines.

THE EXTRACTION OF ZINC IN A BLAST FURNACE.*

By F. L. Clerc, Bethlehem, Pa.

WHILE great improvements have of late years been made in the arts connected with the metallurgy of iron, copper, lead, gold, and silver, the art of extracting metallic zinc from its ores has remained almost stationary, and has come to us with many of the crudities and seemingly barbarous contrivances which marked its infancy. To those who are familiar with the subject, this truth is already painfully evident; to those whose attention has never been drawn to it, the following facts will carry a ready conviction.

To produce a single ton of crude zinc, requires the labor of from ten to fifteen men, and the consumption of from ten to twenty tons of coal; the loss of metal in the operation is, probably, never less than 20 per cent. of the amount contained in the ore, and in many cases it is, undoubtedly, much greater. The operation is altogether so costly and imperfect, that notwithstanding the fact that the metal is a comparatively valuable one, ores containing less than 25 per cent. of zinc will scarcely pay the cost of mining and treatment.

* A paper read before the American Institute of Mining Engineers at Philadelphia, June, 1876.

This condition of things, startling as it is on its first presentation, and never otherwise than humiliating, is, however, not without some excuse, or even a show of necessity; for, if the metallurgy of zinc is less perfect than that of most other metals, on the other hand the metal itself is acknowledged to be one of the most peculiar in its properties and the most difficult of treatment. It cannot be melted and run out of its ores, under the influence of heat and reducing agents, as are most of the common metals; for it is only reduced at a temperature higher than is required to volatilize it, and must, therefore, be obtained by distillation and subsequent condensation. In some respects it resembles mercury, but with important differences. It volatilizes at a much higher temperature, is more easily oxidized by air, steam, or carbonic acid, and must be condensed and collected within certain limits of temperature, since below 417° C. it becomes solid, and collection into a single mass is no longer possible.

Accordingly, we find in all the various processes any where in use, that the ore is treated in closed vessels, called muffles and retorts, and condensed out of the reach of the air or other oxidizing agents. These muffles and retorts are arranged in furnaces and are made of the most refractory material, to resist the intense heat to which they must be subjected—for all the heat required for reduction is transmitted through their fire-clay sides. They are made small, so that the heat may penetrate to the center of the inclosed charge; and they have to be emptied and refilled as often as the charge is exhausted. They absorb the metal readily, are quickly burned out, and require frequent renewing.

The condensation also is very imperfect. Considerable metal escapes into the air and is wasted, and a large proportion of that collected, is in the form of "blue powder," which has to be re-worked. The labor required of the men is incessant and very exhausting, and the extraction of the metal from the charge is far from being complete. It is not an exaggeration to say, that the metal is charged into the furnace in spoonfuls and raked out in drops, that it is distilled in vessels that are porous to its vapors, and that about half of the metal finally obtained has been twice worked.

These remarks apply particularly to the Belgian furnace, the one which is used in this country and generally preferred; but they are more or less true of all other processes. Repeated attempts have been made to extract zinc in cupola and reverberatory furnaces, which, either from special defects in the manner of conducting the experiments, or from some inherent and insurmountable difficulty connected with the operation, have uniformly produced only large quantities of oxide of zinc or blue powder, and have all ended with failure. So obvious is the idea, and so generally has it been tried, invariably with the same result, that practical smelters have come to regard it as wholly chimerical, and even educated metallurgists, no longer sanguine of its successful accomplishment, are disposed rather to apologise for and defend existing systems, with all their imperfections, than to expend much time or money in seeking a better one. This is, I believe, a very great mistake, for I think it will be found on a careful examination that the failure, in every recorded instance, has been due to a misconception of the conditions under which the problem may be solved, and to some radical defect in the construction of the furnace. Having approached the subject in a different direction from that pursued by most other experimenters and reached my final conclusion by a somewhat roundabout course of investigation, I will briefly indicate the course pursued and return from my final conclusion, to contrast it with some of the forms of furnaces hitherto proposed, in which comparison I hope to be able to show the causes of their failure and the means I have taken to overcome the difficulties encountered.

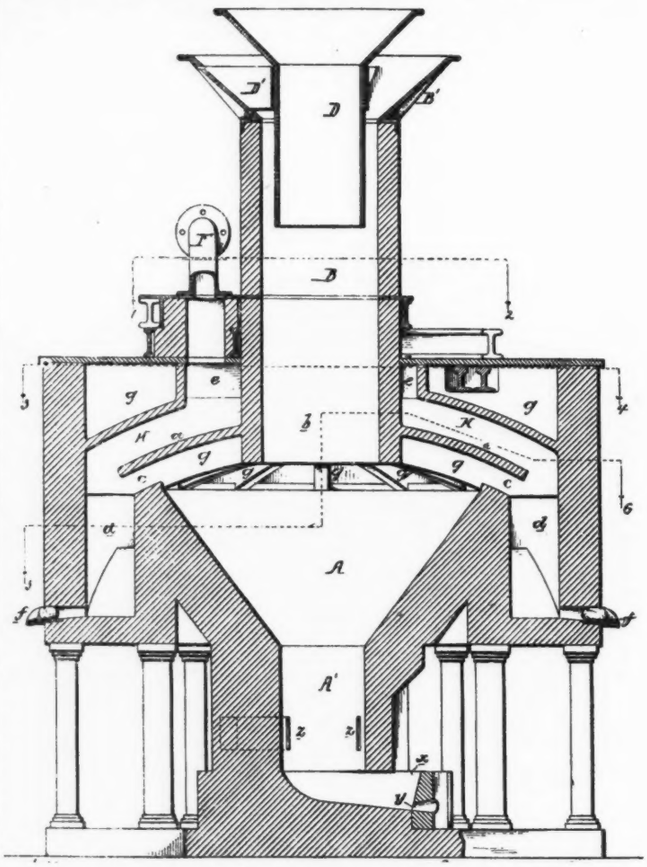
Having observed, as chemist of the Lehigh Zinc Company, the disadvantages of the present method, I was led to think of a gas-furnace, and to experiment whether an improvement might not be made by dividing the operation into two simpler ones, and first obtaining the zinc from the ore in the form of oxide by volatilization, as in the WETHERILL oxide furnace, and afterward feeding it continuously into a brick oven, where it should be acted upon by a stream of intensely heated carbonic oxide. In this way the formation of slag could be avoided, and the operation be made continuous. The furnace gases were to be conducted over charcoal, to reduce the carbonic acid formed in reducing the zinc oxide, and then brought into a fire brick condenser kept hot by its proximity to the furnace. I made the experiment of reduction on a large scale in a SIEMEN'S furnace. The furnace was brought almost to a white heat, and the chimney and air damper were closed. Several hundred pounds of oxide of zinc were then thrown upon the bed of the furnace, and the gases were withdrawn through one of the side doors. Notwithstanding the fact that I had at my disposal only one of the four chambers of the regenerator, and the gas was so poor in carbonic oxide that it would not burn constantly without being heated, and notwithstanding the feebleness of the gas current, which was due only to the ascensional force of the heated gas without the draft of the chimney, I succeeded in volatilizing several hundred pounds of the oxide. But I had no facilities for making the operation continuous, and no arrangements were made for condensing the zinc vapor, it therefore escaped as "blue powder," and burned with the characteristic flame of metallic zinc. This experiment, three times repeated, and careful calculations of the amounts of heat given out and absorbed in the various operations, convinced me that it was entirely practicable to give to the gas current such an initial temperature as would enable it to carry on the work of reduction without the addition of other heat; and I devised such an arrangement of feeding hopper and fire brick stoves, that the operation could be carried on continuously, and such a combination of valves that the stoves could alternately be heated on the regeneration principle, and the current of reducing gas turned through them. But my calculations, carried still further, also convinced me that the issuing gases would not retain sufficient heat to insure the reduction of their carbonic acid in passing over charcoal unless initial temperature were given them higher than I thought it wise to expect to be able to maintain. This difficulty was not, it is true, insurmountable, for the charcoal might be heated by an additional fire; but it was sufficient, added to the already somewhat complicated nature of the process, to turn me back to examine another branch of my original idea, which had at the time seemed less promising, namely, to dispense with the outside generated, and produce the carbonic oxide required in the furnace, by mixing a proportion of fuel with the charge, and injecting upon it a blast of intensely heated air. By this means the same amount of heat could be brought into the furnace by the blast, and the heat before wasted in the generator, could be usefully employed. Starting with this idea, I advanced by easy stages, simplifying and generalizing as I went, to the following process, which will be found to contain all the elements of my original idea, namely:

1st. A finely-divided and specially prepared charge, continuously fed and slowly descending, into the bottom of which is injected a blast of an intensely heated gas.

2d. A deoxidizing layer of charcoal.

3d. A condenser of brickwork kept hot by its proximity to the furnace.

Reference being had to the accompanying figure, the following description will be found intelligible. The furnace is in the form of the inverted frustum of a widely flaring cone *A*, placed on a cylindrical hearth *A'*, and covered by an arched dome *a*. The hearth is provided with tuyeres *z*, a slag eye *x*, and in special cases with the additional tapping hole *y*. In the dome are found a large central opening *b* for the descent of the charge, and numerous lateral openings *c* for the passage of the furnace-gases. Over the central opening in the dome rises a feeding-shaft *B*, the lower portion of which is of fire-brick, and into the top of which extends an inner shaft of iron *D*. The condenser consists of fire-brick flues *H*, extending over the dome of the furnace. In the drawing these flues are twelve in number, and communicate at the top in sets of four through the transverse passage ways *e*. Each set communicates with an iron chimney *F*, of which only one can be seen in the drawing.



Adjacent flues unite at the bottom to form a series of six sumps *d* around the furnace for the collection of the condensed metal.

The operation of the furnace is as follows: The charge, consisting of an intimate mixture of finely-divided calcined ore, fuel, and flux, to which may be added some blue powder from a previous charge, is fed into the inner hopper, and at the same time some charcoal is fed into the outside hopper. These two materials, as they sink in the shaft, unite in a solid column, which spreads out on reaching the furnace, falling with a natural *talus* against the boshes.

The charcoal being on the outside is thrust upward and forms a covering over the charge. As the oxide of zinc comes into the hottest part of the furnace it is reduced, and the zinc, in the form of a vapor, rises with the other gases, passes through the layer of charcoal, and issues into the condenser.

In passing through the layer of hot charcoal, whatever carbonic acid there may be in the gases is reduced to carbonic oxide, in which form it cannot oxidize the metallic vapors. In passing through the condenser the gases part slowly with their heat, the zinc, condensing into drops, settles out of them, and is collected in sumps, from which it is from time to time withdrawn.

The gases should not be allowed to remain in the condenser after they have cooled below the melting point of zinc, or it will become choked with blue powder; nor should they be withdrawn from it while condensation is still possible. The iron chimneys will be found of great assistance, as they indicate the temperature of the issuing gases. It is not to be expected that all the zinc can be collected in the condenser; therefore, after leaving it the gases are rapidly cooled, and what zinc remains in them is washed out in the form of a heavy metallic powder, by means of a drenching shower of water. This blue powder is dried and returned to the furnace in a subsequent charge. The gangue of the ore and the ashes of the fuel are melted up with a flux and run out at the tapping-hole below. The height of the feeding shaft is o, regulated as almost entirely to prevent the escape through it of any of the furnace gases.

Let us return to attempts which have hitherto been made to extract zinc in a blast furnace. The failure in every instance, so far as my observation goes, is attributed to the formation of oxide of zinc, or of blue powder. Although the distinction between these two products is not always clearly made, they are very different in their origin and their behavior in the furnace, and will be considered separately.

(*a*) Oxide of zinc is due to the action of free oxygen, aqueous vapor, or carbonic acid, upon the reduced metal. It acts in various ways to obstruct the operation of the furnace, and if it is produced in considerable quantities, presents insurmountable difficulties to its working. While hot, it forms dense

crusts of "furnace cadmia," wherever it comes in contact with brick work; when in the form of light flakes, it is extremely liable to choke up flues; it cannot be removed by volatilization, or reduced, except at a high temperature; and it forms such a paste with water that it is almost impossible to wash it out of the gases. The only way to prevent its formation is to avoid the presence of free oxygen, aqueous vapor, or carbonic acid in the furnace gases.

There are only two possible sources for these oxidizing agents: either they may be derived from the charge, in the form of water or carbonic acid given off under the influence of heat, or of air mechanically brought down, or else they may be due to the action of the blast, and be products of combustion or reduction.

The first of these possible sources, namely, from the charge, is by far the more probable one, and I am inclined to think would account for nearly all the trouble where failure is attributed to the excessive production of oxide. Yet it is clearly possible to entirely avoid it, 1st, by careful attention to the calcining of the ore and flux; 2d, by employing only such fuel as does not give off water under the influence of heat; and 3d, by displacing the air inclosed in the charge by an upward current of carbonic oxide through the feeding shaft, as I have arranged it in my furnace.

From the second source I do not think any danger is to be apprehended, for these reasons: If there were no reducible oxides present and the furnace were simply filled with such fuel as I have mentioned, and a blast of superheated air blown in at the bottom. it is certain that the ecaping gases would be practically free from either carbonic acid or free oxygen; if now oxide of zinc were introduced in the furnace carbonic acid could only be formed by reducing at points where the temperature is sufficient to reduce oxide of zinc, that is in the neighborhood of 1000° C.; and it can only escape as such by passing unreduced through a finely divided charge containing carbon at the same high temperature. But we know that carbon acts strongly to reduce carbonic acid even at 500° C. All the probabilities are therefore against its escaping unreduced. I have taken the further precaution of maintaining a layer of charcoal on top of the charge in such a way as to be kept hot by heat intercepted from the gases by the reverberating dome. To supplement this *à priori* reasoning, which however seemed to me conclusive, I made the experiment of blowing into a cold charge of oxide of zinc and powdered charcoal a blast of air heated to near the melting point of cast-iron, and found that the zinc was driven off as blue powder, and that *no flakes of oxide appeared until the tuyere was uncovered.*

(*b*) Blue powder is essentially metallic zinc in the state of fine subdivision; for although the particles are generally superficially oxidized, a product essentially like it may be obtained where such oxidation is impossible. Its formation depends upon the conditions under which the zinc vapor is cooled. Although zinc is only reduced from its oxide at a temperature at which it is a gas, it is so near its point of volatilization that it is not probable that it long escapes condensation, or that it is found any where in the furnace in the form of a perfect gas. This is true in the case of zinc reduced in the Silesian muffle or Belgian retort, as well as in a blast furnace. We can then regard it as existing in the form of small liquid globules disseminated through the furnace gases, and the operation, which is generally called condensation, is more properly a collection of these widely-separated globules into one liquid mass.

Anything which impedes this operation of collection which is carried on by the settling of the heavier metallic globules out of the lighter gases, or which cools the gases below the melting point of zinc before it has been carried sufficiently far will increase the production of blue powder.

Blue powder is formed in all the processes of zinc reduction in use and must be encountered in any that can be imagined. It is not necessarily a serious evil, but may become so, owing to a faulty construc ion of the condenser, if it takes place in such quantities as to require the reworking of a large portion of the charge, or if it accumulates in any part of the condenser so as to obstruct the blast and require frequent and troublesome clearings out, or if it occasions loss of metal. The trouble encountered in most cases seems to have come from too narrow flue ways, too sudden cooling of the gases by expansion or otherwise, and too rapid and irregular motion of the gas current; also from the failure to provide appropriate means of collecting separately the liquid zinc and metallic blue powder. I have divided the operation of collecting into two distinct operations, each carried on in its appropriate place.

The condenser is maintained at a temperature at which blue powder cannot be produced; and is given such form and dimensions as will facilitate the settling of the zinc vapor from the slowly moving gases. The iron pipes in which the gases are taken to the washer are so arranged as to be easily cleaned or readily replaced, and the washer is so constructed as to remove almost the last trace of zinc from the washed gases. The effect of blowing moist zinc vapor through any considerable depth of a finely divided charge, can easily be foreseen. The zinc would be intercepted and gather in drops which would trickle down, obstructing the blast until they were again volatilized, occasioning great irregularity and uncertainty in the working of the furnace. The gases ought therefore to be drawn off from the furnace very near the point at which the metal is reduced, and at a temperature near the volatilizing point of zinc. The effect of thus drawing off the gases is to withdraw an immense amount of heat from the top of the furnace which must in some way be restored to the furnace, and to necessitate the use of a shallow charge. This latter effect, however, is to a great extent beneficial, for the shallower the charge, the more finely it may be divided without obstructing the blast; and this fine division greatly facilitates the reduction of the zinc and of the carbonic acid formed by reduction.

The heat withdrawn in the gases may in part be returned to the furnace, by employing them in the preliminary heating of the charge, or to raise the blast to a high temperature. I prefer the latter, though both may be simultaneously employed; as from the manner of feeding the charge into my furnace, it is much more economically heated by the direct contact of the gases than it could be by burning them and transmitting the heat through walls of firebrick. The gases being withdrawn around the sides of the furnace, the zones of equal heat are inclined in the general direction of the boshes, and the charge descending downwards and outwards is brought gradually into the zone of reduction. At the same time a portion of the draft, regulated by the height of the feeding shaft, may without danger of loss of metal, be allowed to force its way up through the feeding shaft, displacing the air and expelling the last traces of water from the charge. On the other hand a high temperature in the blast is in many ways very desirable. It contracts the zone of combustion, increases the activity of reduction, diminishes the volume of the gases, and permits the use of a shallow charge. I have therefore given to the blast a very high temperature and made the charge correspondingly shallow.

In conclusion I would state that, in my opinion, the failure of previous attempts to extract zinc in a blast furnace has been due to one or other of the following causes: either the charge was capable of giving off oxygen, carbonic acid, or water, or the gases were withdrawn at too low a temperature, or improperly cooled, or the top of the furnace was chilled by the intermittent action of charging, or, owing to a faulty construction, the condenser was liable to become choked with a deposit of blue powder; and the manner of their failure encourages me to think that by removing the causes of it I shall meet with the success which they failed to obtain. As the means of removing these several causes of trouble, I have given great care to the selection and preparation of the materials of the charge; I have introduced the use of a superheated blast, a covering of hot charcoal, a shallow and finely-divided charge, and a method of feeding by which the charge is gradually heated before coming into the zone of reduction. I have placed the operation of condensation entirely under control as to temperature, and provided an effective means of recovering the blue powder from the gases.

I am now making arrangements to test, as thoroughly as possible, the value of these improvements, and it may seem premature to publish them in advance of that trial; but as I think the subject of the extraction of zinc in a blast furnace is one which deserves more attention, whether or not I succeed in accomplishing it, and as the present meeting gives me an opportunity, such as may never again present itself, of bringing it before representative metallurgists of all nations, I have decided to lay the result of my investigations before you, and to invite a discussion on the subject.

ABSTRACTS OF LECTURES ON MINING.—No. XII.

By Prof. W. W. Smyth, M.A., F.R.S., Royal School of Mines, London.

(*From the London "Mining Journal."*)

WE have already considered some of the principles which should guide the miner when he is called upon to pronounce a judgment on the question of re-opening an old mine, but it is impossible for us to deal with this branch of our subject in all its details. In various parts of Europe—in the South of Spain, in Asia Minor, etc.—there are large tracts where mining is only carried on at distant intervals, and where there is much room for fresh search. But in many cases it is a question of opening mines formerly worked by Phœnicians, Romans, Greeks, Moors, etc., many of which have been re-opened and worked with advantage. In examining a lode, and testing it as to its value, it is necessary, in order to obtain a satisfactory result, that it be tested at a great number of points, and not merely that junctions or unusually rich portions should be observed, without regard to the poorer ground between. Some of the most monstrous impostures brought into this country have been of this kind, where a lode has been tested at one or two special spots, and then statements have been made on the assumption that the lode throughout would be of the same character, and calculations of the amount of money the lode was worth down to a certain depth deduced from this, whereas any person having the slightest knowledge of mineral veins would know that there was really nothing whatever on which to form a judgment; and where the precious metals occur there is more reason than ever to be exceedingly cautious, and nothing short of actual driving will enable us to form a satisfactory conclusion as to the value of the lode. The correct course is to take fair and average samples of the lode from a great number of separate spots, either from surface or, better still, underground, and then to mix altogether, and sample them as we should the ore from a particular pitch of the mine. Thus, for example, we should build them up into a circular pile, cut it through by cross trenches, and mix the material cut out with other taken from the middle or each quadrant; then make this into another pile, and proceed as before, till we get a fair and workable sample for examination.

We now come to the question as to what kind and what amount of preliminary work there should be in cases where it may be, perhaps, unnecessary and undesirable to raise capital at once, or to expend considerable sums of money on regular mining. In stratified deposits, where we may look for regularity over large areas, much may be done by means of bore-holes, but these are not applicable to the large majority of metalliferous deposits, because, even if we should succeed in striking the lode, we should still be very uncertain whether we had an average or exceptional specimen. With regard to the arrangements entered into for the working of minerals, different systems occur in different countries; these variations are not so notable on the Continent, where most of the minerals belong to the Crown. In England with regard to the holding of stratified deposits, especially coal, there are three principal systems. According to the first you examine a given area of ground, and form your conclusion as to what is likely to occur there, and then you purchase the right of working the coal over that area at so much per foot thick of the seam. In the North of England, more especially in Lancashire and Cheshire, this is the method commonly pursued; and it is well to bear in mind that the Cheshire acre is much larger than the statute acre. The second plan is that of paying a money tonnage, and several points in connection with it need to be carefully attended to—*e.g.* whether the amount shall be the same for different seams of coal, what amount shall be allowed for colliery consumption and for the colliers' coal. The third method is that where the owner lets his coal subject to receiving a certain fractional proportion of its value; and here again several important points have to be looked to in the agreement, the price of coal being that at some port, the question of the cost of conveyance thither has to be determined, in order to obtain the value at the pit's mouth. We shall have to return to this point again hereafter.

With regard to the preliminary examination of metal-bearing repositories, much valuable information can often be obtained by observing what is going on in the neighborhood, which knowledge may save us a considerable amount of time and expense. In some cases nothing short of actual opening of the ground will give you a fair clue to its value. Even in a slate quarry the blasting of a few pieces of rock, in which the cleavage seems perfect, is not sufficient to show the real value of the mass; nothing but the actual working of it can do so. And in our best districts you can scarcely point to one quarry where it did not take £20,000 to £40,000 in opening the ground and testing it before the full value of it became apparent. Where you have the mineral deposits covered over by a great depth of gossan very little can be done by superficial or preliminary trials; here again the preliminary operations must soon merge into actual mining. And in this latter case it would be unwise to make any considerable opening without sufficient capital and sufficient plant to proceed down to a depth of 30 or 40 fathoms, or even in some cases to 60 or 80 fathoms, before we can expect anything like profitable returns. Where the gossan does not run deep these preliminary workings may soon be expected to show whether our search is hopeless or not. Of late years, since it has been the custom for capital to be associated together in limited liability companies, it has been the custom for some persons to open the mines to a certain depth

only, to see what they are likely to produce, and then calling in the assistance of more capital, or disposing of the working. This is a legitimate proceeding if fairly carried out, but in some instances it has been grossly abused; as, for instance, the plan of ceasing working when a particular local rich portion is reached, and then inviting strangers to come and see it, with a view of getting it taken up. It is, therefore, well in such cases to see not merely what our lode is capable of producing at a particular point, but to carry our survey through a sufficient length of ground to enable us to form some idea of the true character and value of it.

There are certain errors into which persons are likely to fall, and frequently do fall, from not observing carefully enough the character of the deposits with which they are dealing. I mentioned the case of the Fawnog Mine, in Wales, where the appearance of the beds led to false conclusions about their true relations. I have here a representation of another case which might mislead a careless person; it is that of the china-clay mine at Schneeberg, in Saxony, where the clay is seen to form a cap, covering the upper part of a dome-shaped mass of granite. It was discovered a little before the middle of last century, and gave rise to the manufacture of the famous Dresden porcelain. The upper part of the clay was very little below the surface of the ground, and if it were seen in a small brook course, a very wrong conclusion might be formed as to its true character, and it might be considered to be a bed. In our own country the general character of such deposits is very different, though they are always found in apposition with granite, and, indeed, are derived from it. Again, suppose we meet with deposits of the character of those in the east side of the Forest of Dean, where the irregular churns occur in rocks tilted so as to stand almost vertically, it would, evidently, be wrong to conclude, merely from an inspection of a churn, or of the sterile rock between two churns, the prospects of working in such ground. It is necessary, in order to judge correctly from these preliminary observations, that we be thoroughly well up in the different kinds of depositories of minerals, and be able to distinguish one class from another. There have occurred cases of the following kind, where thousands of pounds have been spent uselessly, from a want of knowledge of the means of distinguishing between the repositories; indications of mineral at the surface have been taken at once to be that of a lode, whereas they have merely been the outcrop of stratified beds. Shafts have been sunk, or if the outcrop was on a hill-side, levels driven, altogether out of any relation to the real bed, when a little careful observation and study would have revealed its true character. The safest method in such cases is that of sinking, in the deposit itself, as far as possible; but the lecturer holds, that till we know what kind of deposit it is with which we are dealing, money thus spent will be thrown away. Time enough to sink shafts when the nature of the repository is known.

Where we have to make an examination of a lode, or lode-like deposit, it is necessary to test it at several points, and this we can do in a hilly country, in two ways, either by sinking shafts, which are opening more or less vertical, or by driving levels, which are more or less horizontal. The choice between the two will depend on several circumstances, as, for instance, the dip of the hill and the underlie of the lode. The great advantage of a level is, that it drains the ground above it, and may remain in use should the lode prove worth working. If things look well, it may then be worth while to drive other and longer levels lower down the hill, and if the ore ground extends downward, it may be an excellent plan to drive an adit level as far down toward the bottom of the hill as possible, in order to drain the whole hill above. But if it be a totally different, and probably unfavorable rock in that part, it will be well to be satisfied with shallower levels, until the works have been opened, and sufficient capital is secured to enter on the larger level below. If the lode dips with the hill, then it might be most profitable to drive levels, but if it dips against the hill, then in many cases the levels would have to be exceedingly long, and it will be best to sink a series of shafts. In the case of shafts, too, the question of drainage would come in more and more forcibly as the sinking extended, as to whether it would be possible to drain the whole series from one shaft, or whether circumstances rendered it necessary that each single shaft should be made a sump-shaft, in which case great expense would be entailed. Another point to be taken into consideration is that of the character of the ground through which we have to drive. In the North of England it is the fashion to open long levels, driven sometimes for a distance of a mile or a mile and a-half. As to the character of the apparatus for draining, it is desirable that when we come to use steam-power we should not, from false ideas of economy, put up an engine of too small power, which would have to be removed and a larger substituted as the works increased; nothing is more expensive than such constant changing. The question as to whether we are to expect the deposits we meet will go downward, or will impoverish, is an important one. In the case of copper, lead, and tin, we have no reason to expect such impoverishment. In the case of gold and silver it has often been asserted that they do become impoverished with depth, and there can be no doubt that in a large number of mines—especially European, but also some Transatlantic—the proportion of silver in silver ores, and gold in gold-bearing veins, has become considerably less as the depth increased. But that such is not always the case, and as a proof that we may reasonably hope for a proportion being maintained, we have the gold mine of St. John del Rey, which is very productive at great depths, and again, the silver mine of Przibram. Near the top of the latter mine the proportion of silver was 4 to 5 loth (loth = about ½ an ounce English) per cwt.; at a depth of 200 fms. it had increased to 6 or 7 cwt., from which depth it has been pretty steady at 7 or 8.

The lecturer then briefly indicated a few considerations as regards the preliminary operations in connection with mining, which require to be attended to:—1. The consideration of what sort of partnership you are to work under; from whom you are to take the minerals, and on what conditions. 2. The power you can have for your machinery; if water, whether you can always expect it on the spot, or whether it will be necessary to collect it in reservoirs, or convey it for a distance, may be of eight or ten miles, as in some districts of Saxony. The question of the altitude above the sea is also important in this connection; it may be so high as to preclude the idea of a water supply, or it may even be so high as to cause the mines in Winter to be snowed up, or even covered by glaciers, as in some of the mines of the Austrian Alps, or as in those of Utah and Colorado, the men may be exposed to danger from avalanches, etc. 3. The means of carriage to or from the mine, whether there are good roads, or whether, as in the North Country, it may be necessary to use galloways or small ponies, or other animals, for the purpose of carriage over bogs, etc. 4. Whether wood or timber is at hand; or again, especially where smelting operations are necessary, whether other fuel can be obtained; whence coal can be obtained, and its price. 5. The consideration of the wages, skill, and industry of the miners in the district, and proximity of their dwellings to the mines, for if the workman has to come a long distance to his work, you cannot expect so much work from him as if he lived close at hand. This latter is an important consideration; so much so, that it may be advisable, in some cases, to erect temporary barracks close to the mine; this has been done in some northern districts, and this extra expense has been a great drawback. Under this head, also, comes the important point of management. Nothing is easier than to spoil a good mine by bad management, and when once a mine has been thrown into bad shape, it is a very difficult matter to get it into a good form again. 6. The consideration of some matters connected with the surface. It is necessary to caution you against overbuilding, at the outset, large offices, stables, etc., and, among other things, a dining-room for the shareholders to come down and dine in; most of these dining-rooms have been followed by neither dinners nor diners. On the other hand, it is not well to pinch the men, and since the establishment of a system of government inspection in recent years, we shall probably see less of the evils resulting from this. For instance, in some cases the men were obliged to change their wet clothes in the open air, or walk home in them. Or again, a number of men might be seen seated on a high-pressure boiler to dry themselves. Or, as I have seen, a man would hang his heavy wet jacket on the safety-valve to dry. Some stores will be required at hand, and accommodation for them, that it may not be necessary to send long distances to get a wheel repaired, for instance; it is an unwise policy where directors will not give their managers authority to obtain such small things, without insisting on signing an order for everything themselves, and thereby often causing a great deal of delay. Of course, I am not here referring to the very largest class of works, where it will be necessary to have stables, granaries, foundries, and workshops on a large scale.

THE USE OF THE MAGNETIC NEEDLE IN SEARCHING FOR MAGNETIC IRON ORE.*

By Prof. J. C. Smock, of the State Geological Survey of New Jersey.

THE magnetic and polaric properties of magnetite, or magnetic iron ore, are fundamental principles in magnetism. The disturbing effect of this mineral upon the magnetic needle in land surveying must have been very early observed. The difficulties arising from this source are still almost insurmountable in making accurate surveys in districts where this ore occurs to any extent, either as a rock constituent, or in well-defined ore masses. In the Highland range from the Hudson to the Delaware Rivers, the ordinary method of running lines with the compass, is sometimes impossible, and property boundaries are located by well-established landmarks, rather than by the course of the needle. Notwithstanding these well-known facts, the general application of this property of deflection in the needle, by the presence of magnetite, to searches for this mineral, is comparatively of recent date. There are, however, authenticated instances of this use of the magnetic needle more than a century ago. The mining of iron ore in the Highlands began in the early part of the eighteenth century, and the Sterling, Ringwood, Dickerson, Andover, and Oxford Furnace Mines were all worked before the American Revolution. And these, with other old mines of this district, must have been opened shortly after the location of the larger patents and tracts of land, and the settlement of the country. And some of these ore masses were, most probably, discovered through disturbances observed in the action of the needle in making land surveys. This may have suggested the employment of the compass in searches for ore. Such use of the needle was made by the celebrated London Company, that took up the Ringwood tract. This company surveyed the country with thoroughness and success. And nearly all of the older and larger mines in this Highland belt are commonly reported to have been discovered through the use of the compass, in searches for ore.

The more general use of the magnetic needle for this purpose does not go back more than thirty years. In 1854, when the Geological Survey of New Jersey, under the direction of Dr. WILLIAM KITCHELL, began, the ordinary surveyor's compass was used by a few persons who were sufficiently experienced, or skilled by observation, to properly interpret their indications. At that time the number of large mines was not much greater than at the beginning of the century. The introduction of the miner's or dip compass shortly afterward, made the use of the needle much more convenient and extended, and work with it was done with much greater rapidity and accuracy than formerly. Contemporary with its introduction, began the greater frequency of discoveries, and the opening of many new mines and ore localities, so that this might be taken as an era in iron mining in New Jersey. Dr. KITCHELL estimated the amount of iron ore raised in that State, in 1855, at 100,000 tons. In 1864 this had been increased to 264,600 tons, and in 1868 further, to about 300,000 tons. But the increase in the number of mines, from 1868 to 1874, is most remarkable. In the first-named year there were 115 mines and mine-groups, whereas, in 1874, the number of mines and ore localities had increased to nearly 200 in number.

It may be safely stated that all of these were first made known by the use of the needle. Or, in other words, the average annual production of the State had been increased fully fifty per cent. by the addition of these new producing localities found by the compass. So much the iron men owe to this little guide, or *true* divining-rod. It should also be stated, that in many cases there are no surface indications of ore, other than those of the compass.

At the present time, nearly every mine superintendent, and many landowners, have their dip compasses, and, as opportunity offers, go out in search of new lines of attraction. A few persons follow this business as a specialty, and open mines and deal in mineral properties. They are known as "ore hunters," or "prospectors," or "mineral dealers." For several years preceding the panic of 1873, the increasing demand for ore stimulated the search for new supplies, and many lines of attraction were found, and nearly every farm in this long belt was covered by a mineral lease.

MAGNETISM OF MINERALS AND ROCKS.

Magnetite is not, however, the only mineral which may disturb the needle and exhibit the deflection from the plane of the magnetic meridian termed *attraction*. Nor is this phenomenon of deflection confined to rocks containing this mineral. A large number of minerals are capable of producing slight deflection when they are brought near the needle. Serpentine, amphibole, pyroxene, hematite, and franklinite are some of the more powerful of these in their effects upon the magnetic needle. Many rocks also show some magnetism, particularly the darker colored and more dense, igneous, and volcanic rocks. This applies to the rock in masses as well as in hand specimens. In nearly all cases the magnetic disturbance is increased by heating to fusion or by oxidation. Probably in all these cases the magnetism is closely related to the presence or formation of both ferrous and ferric oxides in the mineral or rock species. Many of these exhibit polarity as well as magnetism.

* A paper read before the American Institute of Mining Engineers, at the Washington meeting, February, 1876.

The greater intensity of this disturbing force in rocks and ores near the surface may be thus explained by an oxidation process through the agency of atmospheric forces. For a full statement of this subject of magnetism of minerals see an article by H. Tasche in "Jahrbuch der Kaiserlich-Königlichen Geologischen Reichs-austalt, VIII. Jahrgang, 1857." These phenomena observed in other minerals are interesting, but not of so great practical importance, since the experiment made with delicate instruments rarely showed more than two degrees of deflection. And practically they may be neglected. Very accurate and detailed magnetic surveys will yet need to embrace these elements in their range of work, and these elements will have to be eliminated to get at the correct indications coming from magnetite alone.

Several lines of attraction observed in New Jersey, as yet unexplained, may be owing to the presence of strata containing these minerals, but it is very doubtful.

In practice the attraction is to be referred to the near presence of magnetic iron ore, although the converse is not always correct, since there is a great range in the magnetic intensity exerted by ores, and some are so slightly magnetic that the deflection is perceptible only when the experiments are made with extreme care. Thus it is possible to pass with a dip compass right over large veins of ore, and yet fail to discover any attraction. Slight attractions over large and well known veins are common in New Jersey. But careful surveys will generally reveal the disturbing effect and indicate ore. On the other hand, strongly magnetic and polaric ores are also common. In some instances the attraction is felt powerfully through wide intervals of rock or dirt or air. Hence no conclusions can be safely drawn from the amount of deflection or the magnetic intensity. These differences in the ore render the work of observation in some localities extremely easy, while in others there is need of repeated work, and that done slowly and cautiously.

As a rule the surface ores are most thoroughly magnetic, and this fact makes the survey of unexplored ground more easy. This difference between surface and bottom ores can be seen at almost any mine in this region.

GEOLOGICAL OCCURRENCE OF MAGNETITE IN NEW JERSEY.

The magnetite, as is well known, in this highland range, occurs either as a constituent of the rock strata, or in lenticular masses, imbedded between strata of rocks or walls. These ore bodies, in nearly every instance, have their shoots or longer axes in north-east and south-west lines, descending or pitching to the north-east and dipping toward the south-east, and generally at steep angles. They may, therefore, be considered as approximately lying in the magnetic meridian and in a position to be influenced by terrestrial magnetism. Such an ore body would therefore have one pole at the uplifted or south-west end, while the other would be depressed beneath the surface toward the north-east. And the former ought to attract the north or positive pole of the magnetic needle giving what is termed positive attraction, while the other end would exhibit a negative attraction. Or we may look at the two sides of this flattened, cylindrical ore body, the north-west and south-east, as poles, in which cases the former would give a negative, the latter a positive attraction. And experiments everywhere show these to be the results, just as here predicted of them.

But these ore masses or veins do not all trend in the above stated general or prevalent direction. Sometimes their course is from east to west or approximately such, while in other instances the trend or strike is more nearly north and south.

In the east and west strike the two sides of the vein constitute the poles, and of course such lines are necessarily short, and the magnetism feeble. The more nearly the axis of the shoots of ore or vein correspond to the magnetic axis, other things being equal, the stronger the magnetism and the more clearly the line and character of the attraction.

From these general statements it will be evident that positive attraction will be most commonly observed, the north-east end being too deeply buried to exert any measurable effect upon the compass at the surface, and as a rule the attraction diminishes toward the north-east until it is gradually lost. But from the geological structure of this region it is well known that these veins are very frequently broken by faults or consist of separate shoots, lying in a general north-east and south-west direction. In each of these cases there are a series of ore masses, and the opposite ends of those must show opposite kinds of attraction.

Hence, where there is a fault, and at the interval between two distinct shoots, both positive and negative attraction will be observed within short distances. On the south side it will be negative, on the north positive. Hence, a change from positive to negative entirely across the vein indicates a fault. Such transitions are common, and when met with the projector understands it to be a fault, or offset. It is possible, therefore, *à priori*, to predicate the character of the attraction, if we have given the mode of occurrence of the ore. And from these the converse reasoning is safe, and practice, repeated in hundreds of cases in mining in New Jersey, has proved the correctness of these deductions.

STYLES OF COMPASS.

Formerly the ordinary pocket box-compass, in which the needle is horizontal, was used in searching for attraction, the observer holding it in his hand and noting from point to point the amount of deflection from the magnetic meridian. Sometimes, and where a more careful survey was required, the land surveyor's compass was used, and then lines were run back and forth, across the course of the vein, sighting ahead and noting from point to point in these lines the bearing of the object toward which the line was directed. When these lines were properly located, and the points of observations fixed, and the several observations on them recorded, good work was done. But it was necessarily slow, as each observation required some time, particularly if the attraction was slight.

About ten years ago the miners', or dip compass, was introduced. This has its needle balanced on a horizontal axis, and free to move in a vertical plane only. In the most common form this is from 2 to 4 inches in length and is shut in a flat, circular brass box with glass sides, in some cases open, in more improved forms protected by movable brass plates or covers, which are taken off while in use. This style of compass has superseded the horizontal surveyor's instrument, and has come into very general use. It is often called the dipping needle or dip compass.

As in this form the needle cannot move horizontally, care must always be taken to ascertain the magnetic meridian, and to hold the instrument in the plane of that meridian, otherwise the needle, under the influence of terrestrial magnetism alone, will assume an inclined or vertical position, and thus show a dip, or attraction, where, in reality, there is none. Neglect of this precaution has misled many an observer, and intentional disregard of it has very frequently deceived the ignorant or unsuspecting. The extent to which deception in this manner has been practiced is hardly conceivable by those unacquainted with the magnetic iron ore districts of the Highlands.

In Sweden, a miner's compass, having its needle mounted upon a pivotal joint, which allows of motion, both vertically and horizontally, and inclosed in a glass sphere, or cylindrical brass case, has been used in ore searches. But there is objection to this form in the unsteadiness of the needle, which has so much *play* that more time is requisite in making observations with it.

A newer form, designed by Prof. Cook, of the State Geological Survey of New Jersey, about five years ago, and constructed by W. Emeley, of Troy, removes the objection in the Swedish compass, by allowing the needle, which is balanced on its horizontal axis, to move horizontally through a small fraction of a great circle. This, therefore, shows the magnetic meridian much more quickly than the Swedish instrument; and then, if there be any attraction, it is manifested in the dip, avoiding any possible danger of deception, through the action of the earth's magnetism upon a needle not placed in the magnetic meridian. This most improved compass has its movable brass sides, for safety in carrying, and the ordinary ring set in the brass edge, whereby to hold it. The graduated circle is the same as in the old form. Those who have had much experience in magnetic surveys, give the preference to this compass, as the most accurate, convenient, and most efficient, either for rapid preliminary observations, or for detailed exploration.

In use, the compass is generally held about on a level with the eye of the observer, or so that he can conveniently watch the movement of the needle, and read off the graduated circles the amount of dip. After some experience great dexterity is acquired, and from the vibrations, the experienced eye can readily detect what will probably be the character and the amount of the dip, or attraction. Such an observer may move along on a slow walk and observe, or, as it is technically termed, *catch* the attraction, if there be any in the course he may follow.

SURVEYS.

In a preliminary survey of any given tract, the usual practice is to go rather rapidly on zig-zag lines, from north-west to south-east; or, if attraction be known, or found at any given point, to walk north-eastward and south-westward from that point, following on the supposed, or assumed course of the ore, and thus ascertaining its longitudinal extent. This gives the general direction and length of the line, or belt of attraction. This preliminary survey does not generally require more than a single line of observations, and these are not located or recorded, excepting so far as the observer may refer them, in his memory, to any landmarks that may be prominent or convenient for future observations.

Detailed surveys, or what may be properly termed "magnetic surveys," may be more or less varied, according as the nature of the attraction may seem to require a greater or less number of observations within a given area.

In general, the most convenient and most expeditious method, and, at the same time, that which is best suited to show the character of the attraction or observations, consists in taking observations on lines at right angles to the course of the vein, or across the belt or line of attraction. Where the prevailing course, or strike, is north-east and south-west, as in the Highlands, these should be north-west and south-east lines. Of course, they may be at greater or less distances apart, according as the nature of the attraction may indicate, or the degree of detail demanded in the survey. In general, they may be from 50 to 200 feet apart, or, in exceptional cases, as close as 20 feet. The stations, or points of observation in these lines, may likewise be at varying distances—from five to twenty-five feet apart. Ten feet has been found to be convenient, and sufficiently close for careful and valuable surveys. Such detailed observations, to be of value, must be located and recorded; or, in other words, mapped. For this purpose it is easier to run parallel lines, or such as are approximately so, and make the observations at regular intervals.

Stakes may be driven at the ends of these, and a subsequent survey may be made to locate them. The observed dips, or the amount of attraction, can then be placed at fixed intervals on these lines. Such a method is much more expeditious than a far more detailed survey at *irregular* points. While a great deal of work has been done by the numerous prospectors in this iron ore district, and large areas have been covered by a network of closely-placed observations, very little work has been recorded on maps.

GEOLOGICAL SURVEY OF NEW JERSEY.

The Geological Survey of New Jersey has traced out some lines of attraction, and placed them upon record—upon geological maps—but these do not show the character or the amount of attraction. The scale of these maps is too small for the exhibition of these facts. Three sketch-maps, but of limited areas, giving the observations and their location, appeared in the "Annual Report for the year 1873." These were on a scale of 80 feet to an inch. In these the dots represent the stations, and the figures the observed amount of attraction, the minus sign indicating a negative attraction, and the figures alone, positive attraction.

During the past Summer the Green Pond Iron Mining Company had a magnetic survey made of their large tract of 600 acres of mineral land, in Morris County, about 15 miles south of Dover, N. J. This was crossed in a preliminary survey by lines 200 feet apart, running north-west and south-east, and then the areas, where over 5° of attraction were observed, were covered by lines 50 feet apart, with observations at intervals of 15 feet. This map shows three separate lines or belts of attraction which trend north 54° east (referred to true meridian). The openings on one of these lines have been such as to expose a large *vein* of ore, or rather a long line of *shoots* of ore.

DEDUCTIONS FROM INDICATIONS.

Having made such a survey, we are very naturally asked what inferences follow certain indications or what are such surveys worth. The diversity in the character of lines of attraction may be very great, almost as varied as the possible arrangement of the stations, but certain general characters are recognized as indicative of corresponding occurrences of ore beneath, and all the varied phenomena may be classified in a few groups, described by a few generalizations.

The line of attraction may be long and steady or regular, that is, there may be a line of maxima dips, from which, toward either side, these diminish and at length disappear; and these maxima may correspond more or less closely in amount as well as in location. Such a line indicates regularity below, either in the form of an ore vein or a series of stratified ore-bearing rocks, of nearly homogeneous character throughout. Conversely, if in the line the attraction be irregular in amount, very strong in close juxtaposition with slight or weak attraction, or if the maxima in the several parallel lines which cross the vein, are not in line, but varying from side to side or in amount—on one slight, on the next strong, etc.,—such indications show irregularity in the occurrence of the ore.

Generally such very irregular attraction is found wherever magnetite occurs as an inconstant and accessory mineral constituent of unstratified, granitic, or

syenitic rock masses. Inasmuch as the attraction in such places is apt to be very strong, frequently holding the needle vertically, it very frequently misleads the ore hunter, and many instances of fruitless work in digging and shafting for ore on such attractions have been observed in New Jersey. Popularly a few strong observations far outweigh the longer lines of constant but slight dips. But there is a variation in the character as well as in the amount of the dip, that is, the dip or attraction is sometimes positive and sometimes negative. And here, too, the transitions from the one to the other may be very sudden, and frequently recurring within limited areas.

From what was stated at the outset, positive attractions would be anticipated as the predominent character, prevailing along the whole line, excepting on the north-west side, and in those cases where the ore may not be continuous, either on account of faulting or in consequence of its occurrence in separate shoots, lying in an *en echelon* arrangement in the general course of the vein. In these a negative attraction would be anticipated, and this is found to be the case. And hence such transitions from positive to negative are indications of breaks in the ore mass—faults or separate ore-shoots. Repeated observations over faults prove this.

CONCLUSIONS.

This method of examining ground for magnetic iron ore is so well understood and so extensively practiced in New Jersey, that such a description is hardly more than a statement of facts there gathered.

In the further extension of such surveys, greater care is highly requisite both in the manner of taking observations and in recording them upon carefully constructed maps. Hereafter more attention must be paid to the slighter attractions and to the regular work of accurately mapping them. Such care is necessary, not only to discover new lines, but also to so ascertain the character of known ones as to enable the miner to locate properly his trial pits and shafts. And it appears proper to put this before the attention of mining engineers and geologists, wherever there are magnetite iron ores, since careful preliminary works with the magnetic needle may in other States as well as in New Jersey, largely increase the number of localities whence our supplies of ore may be drawn.

A DISSERTATION ON THE THEORY AND PRACTICE OF WINDMILLS.

By Alfred E. Wolff, M.E.

(Continued from page 236.)

Best Angle of Impulse.—From formula (A) it is apparent that the effect increases with the velocity c, and with the area S, but it is not so evident from it how the angle of impulse affects the mechanical effect produced. That Lv may not be zero, sin a must be $>\frac{v}{c}\cos a$ and cos a must be >0. If sin $a > \frac{v}{c}\cos a$, tan $a > \frac{v}{c}$ and as cos a >0 therefore $a < 90°$. There must therefore be a value of a between the limit tan $a > \frac{v}{c}$ and $a < 90°$, corresponding to a maximum value of Lv. To find the value, we solve the expression $\left(\sin a - \frac{v}{c}\cos a\right)\cos a$ for a maximum by the laws of calculus, and obtain

$$\tan^2 a - \frac{2v}{c}\tan a = 1 \qquad (1)$$

$$\tan a = \frac{v}{c} + \sqrt{1+\left(\frac{v}{c}\right)^2} \qquad (2)$$

Having given the velocity of the wind, the number of revolutions of the sail, and the dimensions of the sail, the shape of the surface producing the maximum effect, and the corresponding theoretical effect can be readily found.

Let c = velocity of the wind in feet per second.
" n = number of revolutions of the windmill per minute.
" $b_0, b_1, b_2, \ldots b_x$, be the breadth of the sail at distances $l_0, l_1, l_2, l_3, \ldots l$ respectively from the axis of the shaft.
Let l_0 = distance from axis of the shaft to the beginning of sail proper.
" l = " " " " " " " " " extremity of sail proper.
" $v_0, v_1, v_2, v_3 \ldots v_x$ be the velocity of the sail in feet per second at distances $l_0, l_1, l_2, l_3 \ldots l$ respectively from the axis of the shaft.
Let $a_0, a_1, a_2, a_3 \ldots a_x$, be the angles of impulse for maximum effect at distances l_0, l_1, l_2, l_3 respectively from the axis of the shaft. Then will

$$v_0 = .10472\, l_0\, n$$
$$v_1 = .10472\, l_1\, n$$
$$v_2 = .10472\, l_2\, n \ldots\ldots$$
$$v_x = .10472\, l\, n$$

And from (2): $\tan a_0 = \frac{.10472\, l_0\, n}{c} + \sqrt{1+\left(\frac{.10472\, l_0\, n}{c}\right)^2}$

$$\tan a_1 = \frac{.10472\, l_1\, n}{c} + \sqrt{1+\left(\frac{.10472\, l_1\, n}{c}\right)^2}$$

$$\tan a_2 = \frac{.10472\, l_2\, n}{c} + \sqrt{1+\left(\frac{.10472\, l_2\, n}{c}\right)^2}$$

$$\ldots\ldots \tan a_x = \frac{.10472\, l\, n}{c} + \sqrt{1+\left(\frac{.10472\, l\, n}{c}\right)^2}$$

From these equations can be found the angle which the direction of the wind must make with the sail at any point on its surface, in order to give the best effect. As the shaft of the windmill is parallel to the direction of motion of the wind, these angles represent also those which the elements of the surface at distance $l_0, l_1, l_2 \ldots l$ make respectively with the axis of the shaft; or, the elements of the sail must make the complements of these angles (angles of weather) with the plane of motion of the sail. Having, therefore, found the angles of impulse as indicated above, the shape of sail for maximum effect is determined. The theoretical effect for this sail is computed by application of formula (A).

$$\text{L}v = \frac{S K c^2 d}{g} v \left(\sin a - \frac{v}{c}\cos a\right)\cos a$$

From (1) we have $v = \frac{c}{2}\frac{\tan^2 a - 1}{\tan a} = \frac{c}{2}(\tan a - \cot a)$

Substituting this value of v into (A).

$$\text{L}v = \frac{S K d c^2}{2g}(\tan a - \cot a)\left(\sin a - \frac{\tan a - \cot a}{2}\cos a\right)\cos a.$$

$$\text{L}v = \frac{S K d c^2}{2g}\left(\tan a \sin a \cos a - \cot a \sin a \cos a - \frac{\tan a\,(\tan a - \cot a)\cos^2 a}{2} + \frac{\cot a\,(\tan a - \cot a)\cos^2 a}{2}\right)$$

$$\text{L}v = \frac{S K d c^2}{2g}\left(\sin^2 a - \cos^2 a - \frac{\tan^2 a \cos^2 a}{2} + \frac{\tan a \cot a \cos^2 a}{2} + \frac{\cot a \tan a \cos^2 a}{2} - \frac{\cot^2 a \cos^2 a)}{2}\right)$$

$$\text{L}v = \frac{S K d c^2}{2g}\left(\sin^2 a - \cos^2 a - \frac{\sin^2 a}{2} + \frac{\cos^2 a}{2} + \frac{\cos^2 a}{2} - \frac{\cos^4 a}{2\sin^2 a}\right)$$

$$\text{L}v = \frac{S K d c^2}{2g}\left(\frac{(\sin^2 a}{2} - \frac{\cos^4 a)}{2\sin^2 a}\right) = \frac{S K d c^3}{4g}\left(\frac{(\sin^4 a - \cos^4 a)}{\sin^2 a}\right)$$

$$\text{L}v = \frac{S K d c^3}{4g}\left(\frac{(\sin^2 a + \cos^2 a)\ (\sin^2 a - \cos^2 a)}{\sin^2 a}\right) = \frac{S K d c^3}{4g}\left(\frac{(2\sin^2 a - 1)}{\sin^2 a}\right)$$

$S = (l - l_0)$ B, B = mean breadth of sail; and $\text{L}v = \frac{(l-l_0)}{4g} K d c^2 \text{B} \frac{(2\sin^2 a - 1)}{\sin^2 a}$

$\text{B}\frac{(2\sin^2 a - 1)}{\sin^2 a}$ = the mean of $\left(\frac{(2\sin^2 a_0 - 1)}{\sin^2 a_0} b_0, \frac{(2\sin^2 a_1 - 1)}{\sin^2 a_1} b_1, \ldots \frac{(2\sin^2 a_x - 1)}{\sin^2 a^x}\ b_x\right)$

Therefore, the theoretical mechanical effect of the windmill of shape of sail, for maximum effect (when N = number of sails of windmill) equals

$$\text{N}\frac{(l-l_0)\ K d c^3}{4g} \times \text{mean of}\left(\frac{2\sin^2 a_0 - 1}{\sin^2 a_0} b_0, \frac{2\sin^2 a_1 - 1}{\sin^2 a_1} b_0, \ldots \frac{2\sin^2 a_x - 1}{\sin^2 a_x}\right) b_x \quad \ldots\ldots\text{(B)}.$$

If the sail is a plane, the angle of impulse a, will be a constant quantity, and hence we find (from (A)) for the theoretical mechanical effect of a windmill with plane sails, the value

$$\frac{(l-l_0)\ kc^2 d\,\text{N}}{g} \times \text{mean of}\left(v_0 (\sin a - \frac{v_0}{c}\cos a)\ b_0 \cos a \ldots\ldots\right.$$

$$\left. v_x (\sin a - \frac{v_x}{c}\cos a)\ b_x \cos a\right) \ldots\ldots\text{(C)}$$

Loss of Effect by Friction of the Shaft.—In calculating the amount of friction, the whole weight of the wheel is taken as bearing upon the neck gudgeon, and the pressure upon the lower bearing is not considered. This certainly seems, at first sight, like finding an excess of friction, part of the weight evidently resting upon the lower bearing; but it must be remembered firstly, that this excess is compensated by the fact that no attention is paid to the axial component of the pressure of the wind, and, secondly, by the fact of the considerably greater diameter of the upper, than of the lower, bearing.

Let W = weight of windwheel in pounds.
" f = co-efficient of friction of shaft and bearings.
" n = number of revolutions of the windmill per minute.
" D = diameter of upper bearing in feet.

The work expended in overcoming the friction will equal the amount of friction into the velocity with which it is overcome. This velocity in feet per second = .05236 n D, and the loss of effect by friction = f W × .05236 n D which, subtracted from (B), makes the actual mechanical effect of a windmill, with sails of best angles of weather, =

$$\frac{(l-l_0)\ kdc^3}{4g} \times \text{mean of}\left(\frac{(2\sin^2 a_0 - 1)}{\sin^2 a_0} b_0 \ldots\ldots \frac{(2\sin^2 a_x - 1)}{\sin^2 a_x} b_x\right) -$$

f W × .05236 n D .....(B¹)

Subtracting the loss of effect by friction of the shaft from (C), we have for the actual mechanical effect of a windmill with plane sails, the value

$$\frac{(l-l_0)\ kc^2 d\,\text{N}}{g} \times \text{mean of}\left(v_0 (\sin a - \frac{v_0}{c}\cos a)\cos a\, b_0 \ldots\ldots v_x (\sin a - \frac{v_x}{c}\right.$$

$$\left.\cos a)\cos a\, b_x\right) - f\,\text{W} \times .05236\ n\,\text{D} \ldots\ldots (\text{C}^1).$$

For the co-efficient of friction in shafts, see MOLESWORTH'S "Pocket Book of Engineering," formulæ, page 216.

Proof of Accuracy of Formula (B).—It is always well to put a formula, however evident it may appear theoretically, to a practical test, to ascertain its truth, and the practical test applied in this case is the comparison of the effect produced, as given as the result of COULOMB'S experiments, and the effect as deduced from the formulæ. COULOMB found as the total effect, including friction of the shaft, 1,000 lb. raised 253 pieds de roi=269·6 English feet for a wind mill of the following dimensions and given conditions: Length of sail= l=33 French feet=35·171 English feet; distance from axis of shaft to beginning of sail= l_0 =6 French feet=6·395 English feet; breadth of sail=about 6·2 French feet=6·6195 English feet; number of revolutions per minute=n=13; number of sails=N=4; velocity of wind about 20·5 French feet per second=21·982 or about 22 English feet per second; angle of impulse at l_0 nearly 60°, angle at l= 78°. The intermediate angles are not given, but, judging by the agreement of the angles of impulse at l_0 and l_1, the windmill can be considered as having a sail very nearly of shape for maximum effect.

Let l_0 = 6·395 ft. Then v_0 = 8·70590 ft. per sec., $\tan a_0$ = 1·48861, ∴ a_0 = 56° 6′ 30″
" l_1 = 11·171 " " v_1 = 15·23498 " " $\tan a_1$ = 1·94388, ∴ a_1 = 62° 46′ 38″
" l_2 = 15·987 " " v_2 = 21·76406 " " $\tan a_2$ = 2·45017, ∴ a_2 = 67° 45′ 26″
" l_3 = 21·783 " " v = 28·29314 " " $\tan a_3$ = 3·00713, ∴ a_3 = 71° 36′ 20″
" l_4 = 25·579 " " v_4 = 34·82222 " " $\tan a_4$ = 3·54901, ∴ a_4 = 74° 15′ 50″
" l_5 = 30·375 " " v_5 = 41·35130 " " $\tan a_5$ = 4·12235, ∴ a_5 = 76° 21′ 54″
" l = 35·171 " " v_x = 47·88038 " " $\tan a_x$ = 4·70488, ∴ a_x = 78° 0′ 2″

$\frac{(2\sin^2 56°6'30'' - 1)}{\sin^2 56°6'30''} = .54880$

$\frac{(2\sin^2 62°46'38'' - 1)}{\sin^2 62°46'38} = .71747$

$\frac{(2\sin^2 67°45'26'' - 1)}{\sin^2 67°45\ 26} = .83275$

$\frac{(2\sin^2 71°36'20'' - 1)}{\sin^2 71°36\ 20''} = .88941$

$\frac{(2\sin^2 74°15'50'' - 1)}{\sin^2 74°15\ 50} = .92060$

$\frac{(2\sin^2 76°21'54'' - 1)}{\sin^2 76°21'54''} = .94115$

$\frac{(2\sin^2 78°0'2'' - 1)}{\sin^2 78°0\ 2} = .95483$

The mean value of which, according to SIMPSON'S rule=·84458, substituting the above values in Equation (B)

$$\text{L}v = \frac{4 \times 6.6195 \times 28.776}{4} \times \frac{.93 \times dc^2}{g} \times 22 \times .84458$$

and assuming the temperature at time of experiment=50°F. and the barometric

pressure=2088·5 (at 32°F. this=2116·5), $\frac{dc^2}{g}$=1·2 and Lv6=·6195×28·776×·93×1·2×22×·84458—3949·9 ft. lb. per second=236,994 ft. lb. per minute=1,000 lb. raised 236·994 ft. per minute. It will be noticed that the effect as here calculated from the formula is smaller than the actual effect, while on account of the better angles of impulse it should be somewhat larger; but if the barometric pressure had equalled 2349·81 (at 32° this=2381·06) then, $\frac{dc^2}{g}$=1·35 and Lv=6·6195×28·776×·93×1·35+·84458=266,618 ft. lb. per minute=1,000 lb. raised 266·618 ft. per minute; or, if instead of c=22 English feet the velocity had been 23 English feet per second, $\frac{dc^2}{g}\times c=\frac{39·669771}{\frac{15903·20}{529}-·018743}\times 23=30·36$ (the barometric pressure being assumed=2088·5) and the Lv=6·6195×28·776×·93×30·36×·84458=4541·4 ft. lb. per second=1,000 ft. lb. raised 272·486 English ft. per minute, which is slightly above the effect found by experiment. Now the barometric pressure, at the time of the experiment, may have been 2381·6 lb. per square foot, just as likely as 2088·5, no account of it having been taken; also, judging from the method by which the velocity of the wind was ascertained, an error of one foot per second was very easily possible, and it is even probable that the velocity of wind found differed somewhat from the velocity with which the wind struck the mill, no anemometer being employed. However, the close approximation between the results, as determined by calculation and by experiment, is immediately discernible, and various formulæ extant tested by the writer in the same manner failed to give nearly as satisfactory results.*

BLAST FURNACE PRACTICE.

TO THE EDITOR: SIR—Your correspondent F. seems to have found something in my paper on Blast Furnace Statistics which I did not put there. I am as hopeful of the high furnaces as he is, and, to judge from his letter, he is as certain as I that heretofore they have not been a uniform success. My remark, upon which he animadverts, was meant to point out that while the mere increase in the size of furnaces was once a doubtful problem in iron smelting, the possibility of building and working mammoth furnaces with good effect has been settled for coke practice, but is still unsettled for anthracite; and, I may add, for charcoal practice. It is not the building of great stacks so much as the discovery of the way to make them profitable when fed with anthracite coal, that forms the line of future improvement. Perhaps F., looking at his own success too closely, is unduly impressed with the ease and readiness with which this work can be accomplished. But his admission that the high furnaces have more frequently failed in entirely new works, than when put up in old establishments, is proof that the method of fitting huge stacks to the working of anthracite is not yet generally known. I believe there is no such state of things in the coke practice where excellent results have been obtained, both at home and abroad, with brand new works. In spite of F.'s confidence, I still think that very few furnacemen know how to bring the fuel consumption in anthracite stacks down in anything like that proportion that has been obtained in coke, whether by high furnaces or any other means, and that the difference in the quantity of anthracite and coke used to make a ton of iron depends on causes that are not understood. The five per cent. of volatile matter in anthracite does not explain it. Charcoal, as now burned, has 20 or 30 per cent. of volatile matter in it, and yet it is the most economical of fuels.

One thing in the charcoal practice of Lake Superior is worth noting. The best furnaces there are not the largest. The largest are, in fact, wasteful of fuel compared with small stacks. If the best furnaceman in that region received orders from his company to build a stack which should make sixty tons a day, with the same consumption of charcoal per ton that the present champion stacks, making thirty tons daily, use, I venture to say he would be puzzled to comply. He could not even guarantee to build a 45-ton stack which should work as well as those of two-thirds the size. This state of things may not be due to a positive limit to the size of stacks when charcoal is the fuel. It is not certain, nor do I think it probable, that there is such a limit. But the method of working the expansion successfully is not generally known, if it is known at all.

JOHN A. CHURCH.

TARRYTOWN, N. Y.

* The formulæ referred to are 1, RANKINE's formula, given in his "Steam Engine and Other Prime Movers," page 216, of which the differences (see also page 215) will be evident from the foregoing Mathematical Considerations, and 2, That given by WEISBACH, whose errors in solution have been pointed out in this paper.

INTERNATIONAL EXHIBITION OF 1876.

Special Report of the Engineering and Mining Journal.

ADMISSIONS FOR THE WEEK ENDING OCTOBER 9, 1876.

Date.		Paying Visitors.	Press, Complimentary, and Exhibitors.	Total Visitors.
Previously reported		4,823 040	1,309,629	6,132,669
October 3	126th Day	80,857	12,566	93,423
" 4	127th "	90,886	12,203	103,089
" 5	128th "	89,060	11,886	100,946
" 6	129th "	76,148	12,044	88,192
" 7	130th "	73,073	12,261	85.334
" 9	131st "	71,808	12,672	84,480
Totals		5,304,872	1,383,261	6,688,133

The King Alfred Silver Mine is a London incorporation, located in Lander County (Nevada), on which a shaft 820 feet has been sunk, cutting the extensions of some of the principal ledges of Lander Hill about 15 in all (many of them carrying very rich ore, one at least that had some $5,000 worth), and varying in width from 20 inches to 8 feet. The tests of the ore, so far as made, have proved satisfactory, and a beginning has been made by starting from the 500-feet level, contracts also being let to run drifts east and west along the ledge. It is contemplated continuing the developments until all the ledges are tapped from different points in the shaft. We were much interested in the workings of some portions of the machinery at this mine, not in ordinary use, that seemed worthy of mention, for which due credit should be given to Capt. MCGLENNON, the Superintendent. The engine is a 30-horse power (link-motion), the reels having cog gearing, and worked by clutches. The advantage claimed in this case is, that any weight can be lowered by steam, or if necessary the same end can be accomplished by the use of the brake strap, by simply throwing out the clutch. In addition to this, the reversing of the engine and management of the clutch are so arranged as to be under the full control of the engineer, nearly 50 feet distant, thus dispensing with the services of an assistant. Two boilers were found necessary for running the engine and other machinery in connection with two steam pumps, one of which is at the bottom of the shaft, and the other at the 400-feet level, to raise the water.

POLAR MICA.—New Haven, Conn., Oct. 12—The schooner *Era* left New London, June 6, well supplied with mining implements, tramways, and all appliances for the excavation of minerals, and under command of Lieut. MINTZER, formerly of the Polaris expedition. The destination and object of the voyage was kept secret. The schooner has just returned. She went to Cumberland Inlet, a place known to whalemen as Niattic Valley. Two gangs of men were put to work about 1,300 feet above the level of the sea, and were assisted by Esquimaux in blasting mica and taking it on board by tramways. From ten to fifteen tons were blasted out of the veins, about ten feet below the surface, when the veins gave out, and no more could be secured. Some of the blocks are remarkably large and clear, measuring 18 by 21 inches in thickness, and weighing about 50 pounds. The mica is said to be worth from $5 to $12 per pound. The schooner on her way here was delayed eleven days by ice. It is said she will now proceed to Philadelphia.

FRIGHTFUL BOILER EXPLOSION AT PITTSBURG PA.—A terrible accident occurred at Pittsburg, Pa., Oct. 12, by the explosion of a battery of boilers in the nail factory adjoining the rolling mill of ZUG & Co., at least 150 men and boys were engaged in the factory preparing iron and cutting it up into nails. The building was filled from one end to the other with rapid running nail cutters and the concern was working up to its fullest capacity to fill back orders. About 8:45 A. M. there was a terrific shock which was felt in many places througout the city. In the immediate vicinity of the mills it resembled an earthquake and people were lifted from their feet. Accompanying the shock was a black cloud or mass of broken timbers, pieces of iron, great lumps of coal, and volumes of jet black smoke, which ascended upward of 200 feet into the air. Thus, in an instant, the extensive nail factory was reduced to a perfect wreck. The work of devastation was most complete, and to add to the horror of the scene, the deplaced timbers and beams, dry as tinder, took fire from the furnaces, while the air was filled with shouts and groans of the poor wretches who lay buried beneath the debris. For a time everybody seemed paralyzed, but as soon as possible an alarm of fire was struck, and the incipient conflagration was soon stopped. The cause of the explosion is given out as a mystery, but there is hardly any question but that the boilers were rotten, as they had been used quite a number of years. Engineer BURKE was seriously injured. After the explosion he was found with his hand on the throttle, alive, but unconscious. The loss of life by the accident this morning can only be estimated now, as many of those injured will hardly survive the night. Thus far fifteen persons are dead and quite a number are yet suffering the agonies attending fatal injuries while scores of others escaped with broken limbs or gashed heads and faces. The loss of life would have been far greater had not the explosion occurred when a number of the workman were at lunch. Pieces of iron, large and small, were hurled in almost every direction. A large portion of the boiler, weighing fully 300 pounds, was thrown into the Allegheny River, about 400 feet from the mill.

STATISTICS OF COAL PRODUCTION.

This is the only Report published that gives full and accurate returns of the production of our Anthracite mines.

Comparative Statement for the week ending Oct. 7.

Tons of 2,240 lb.	1876. Week.	1876. Year.*	1875. Week.	1875. Year.*
Wyoming Region.				
D. and H. Canal Co.	56,875	1,410,264	21,040	2,362,194
D. L. and W. RR. Co.	64,807	1,245,238	40,359	2,354,698
Penn. Coal Co	27,596	766,140	31,430	1,040,537
L. V. RR. Co.	30,375	723,905	19,665	723,295
P. and N. Y. RR. Co.	—	17,488	600	79,892
C. RR. of N. J.	26,761	949,080	60,912	989,470
Penn. Canal	14,369	303,251	12,853	212,728
	220,783	5,424,366	186,859	7,762,814
Lehigh Region.				
L. V. RR. Co.	74,470	1,914,058	91,783	1,377,186
C. RR. of N. J.	33,860	1,001,405	44,090	461,744
D. H. and W. B. RR.	625	32,327	3,624	61,691
	108,955	2,947,790	139,497	1,900,621
Schuylkill Region.				
P. and R. R. RR. Co.	158,863	3,327,561	173,442	3,260,597
Shamokin & Lykens Va.	20,371	638,273	24,932	937,447
	179,234	3,965,834	198,374	4,198,044
Sullivan Region.				
Sul. and Erie RR. Co.	—	27,663	650	6,207
Total	508,972	12,365,653	525,380	13,867,686
Increase	—	—	—	—
Decrease	16,408	1,502,033	—	—

* Year beginning January 1st.

The above table does not include the amount of coal consumed and sold at the mines, which is about five per cent. of the whole production.

Perth Amboy business:

	Tons.
Received for the week	18,280
Shipped for the week	22,859
On hand Oct. 7	68,409

Coal Shipped at Pictou, N. S., for week ending Sept. 30 1876 ..... 6,160 tons.
Previously exported, since Jan. 1 ..... 127,401 "
Total to date 133,561

Receipts of Coal at Boston, for the week ending Oct. 6, and years from Sept. 1, 1875 and 1876.

From	Week. Tons.	Previously. 1876. Tons.	1875. Tons.
Alexandria and Georgetown	5,028	2,760	20,127
Philadelphia	50,478	52,982	128,421
Baltimore	7,357	10,893	25,920
Other places	20,185	22,952	54,097
Great Britain	124	347	604
Nova Scotia	1,564	5,407	6,671

The Production of Bituminous Coal for the week ending Oct. 7, was as follows:

Tons of 2,000 lb., except where otherwise designated.

	Week, Tons.	Year, Tons.
Cumberland Region, Md.		
Tons of 2,240 lb	51,273	1,366,105
Barclay Region, Pa.		
Barclay RR., tons of 2240 lb	7,788	255,462
Broad Top Region, Pa.		
Huntingdon and Broad Top RR	1,884	118,222
*East Broad Top	1,116	51,779
Clearfield Region, Pa.		
*Snow Shoe	635	39,039
*Tyrone and Clearfield	15,716	859,585
Allegheny Region, Pa.		
*Pennsylvania RR	3,467	155,893
Pittsburgh Region, Pa.		
*West Penn. RR	3,949	150,750
*Southwest Penn. RR	944	43,415
*Penn. & Westmoreland gas coal, Pa. RR.	20,405	614,364
*Pennsylvania RR	11,877	218,341

* For the week ending Sept. 21.

The Production of Coke for the week ending Sept. 21.

Tons of 2000 lb.	Week.	Year.
West Penn. RR	759	35,218
Southwest Penn. RR	14,014	387,199
Penn. & Westmoreland Region, Penn. RR.	1,126	39,295
Pittsburgh, Penn. RR	1,988	121,095
Total	17,887	582,807

COAL TRADE REVIEW.

NEW YORK, FRIDAY EVENING, Oct. 13, 1876.

Anthracite.

THE decline in the demand for coal is much more observable than at the date of our last, and is acknowledged with but few exceptions, although some sizes and special qualities of coal appear to be in short supply yet. The demand from those who desire to avail themselves of water transportation, who are unable to secure it after cold weather sets in, has been almost supplied, and at best can last but a very short time longer. When this demand, which has largely contributed to making a few weeks of very brisk trade, has become entirely extinct, a perceptible decrease of business will probably be observable. It is difficult to say just what prices are being

realized for coal, but it is very evident that circular rates do not rule. The Pennsylvania Coal Company announces 100,000 tons of its coal to be sold at auction on the 20th inst. Another auction sale this month is considered as a certainty, while a third is very probable. The financial necessities of both large and small companies are likely to have a very demoralizing effect on prices. It is rumored that one of the large companies has hypothecated a considerable quantity of its coal.

The production of anthracite coal last week was over 40,000 tons less than during the previous week, and over 16,000 tons less than during the corresponding week of 1875.

Bituminous.

THE production of coal in the Cumberland Region for the week ending October 7, was within about 3,000 tons of being as great as during the corresponding week of 1875, making the total decrease this year 448,888 tons. The high rates of freight, and the low quotations for Clearfield coal, have a tendency to decrease the business of this region. Clearfield coal is in better demand, although the prices realized are, as a rule, quite unremunerative.

Coal Trade of Philadelphia.

PHILADELPHIA, Oct. 12, 1876.

From our Special Correspondent.

THE local trade remains active. The orders for shipments are diminishing rapidly, owing partly to the demand for coal at tide water having decreased, and partly to the freights, which are too high, compared with rates from New York to Eastern ports. The supply of coal at the mines is now ample. Vessels are scarce. Rates looked like weakening a few days ago, but are firm again at $2 to Boston, $1.60 to Providence. It is the general impression that the trade will be quite dull after this month. The sudden change from high to low prices caused a rush which induced producers to make efforts to meet the demand, and now that the production has reached a high figure it proves too much for the demand. The want of orders for manufacturing purposes causes a larger proportion of the domestic sizes to be made, and consequently the usual fall demand is met more promptly than usual. Considerable slacking must take place very soon in the production, or there will be, before many weeks, a very serious blockade.

Wholesale Prices of Anthracite Coal for Oct., f.o.b. at the Tide Water Shipping Ports per ton of 2240 lb.

	Lump.	Steamer.	Grate.	Egg.	Stove.	Chestnut.
Wyoming Coals.						
‡Lackawanna and Scranton at Hoboken and Rondout	3 25	3 30	3 40	3 50	4 25	3 75
Pittston at Newburg	3 10	3 10	3 25	3 35	4 10	3 60
Wilkesbarre at Port Johnston	3 25	3 25	3 50	3 50	4 25	3 50
Plymouth, R. A.	....	....	3 50	3 50	4 30	3 50
Susque. Coal Co. at Amboy W.A.	3 25	3 25	3 50	3 50	4 00	3 30
Kingston at Hoboken	3 25	3 25	3 40	3 50	4 25	3 50
Lehigh Coals.						
Old Company at Port Johnston	4 00	....	3 60	3 60	4 00	3 30
Old Company's Room Run "	4 00	....	3 60	3 60	4 00	3 30
Sugar Loaf, Hobok. & Amb. "	4 00	....	3 60	3 60	4 00	3 30
Lehigh Coal Exchange "	4 00	....	3 60	3 60	4 00	3 30
Honey Brook Lehigh	4 00	....	3 60	3 60	4 00	3 30
Beaver Meadow at South Amboy	4 00	....	3 60	3 60	4 00	3 30
Schuylkill Coals at Philadelphia.						
Schuylkill white ash	3 20	3 20	3 20	3 20	3 70	3 20
Schuylkill red ash	....	....	....	3 30	3 80	3 20
Lorberry	....	....	4 20	4 20	4 20	3 25
Lykens Valley	....	....	4 70	4 70	4 70	3 70
North Franklin red ash	....	....	4 20	4 20	4 20	3 25

‡ Boats towed by the D. & H. Co. at its expense to and from New York harbor.

	Per ton.
Freight from Hoboken and Weehawken to New York	45c.
" " Elizabethport & Port Johnston to N. York	45c.
" " South Amboy to New York	45c.

Freight by the boats of the companies from Hoboken, Port Johnston, Weehawken, Rondout, South Amboy and Perth Amboy to New York City and vicinity 50c.

Freight by the Pennsylvania Coal Company's boats from Newburg to New York 65c.

Lackawanna coal delivered to carts in New York or Brooklyn, 50 cents per ton additional.

Wholesale Prices of Bituminous Coal.

Domestic Gas Coals.

Per ton of 2240 lb.	At the Shipping Ports.	Alongside in New York.
Westmoreland and Penn. at Greenwich, Philadelphia	$4 70	$6 00
" " at S. Amboy	5 50	6 00
Red Bank Cannel Pa. at Philadelphia	8 00	8 50
" " South Amboy	8 50	....
" Orrel	6 00	6 50
Youghiogheny, Waverly Co., at Balt	4 25	5 65
Despard, West Va	4 50	6 00
Murphy Run, West Va., at Baltimore	4 50	5 85
Fairmount, West Va., " "	4 40	5 70
Newburgh Orrel, Md. " "	4 50	6 00
Cannelton Cannel, W. Va	....	10 00
" Splint, " at Richmond	5 50	7 00
" Gas Coal at Richmond	4 15	5 65
Peytona Cannel W. Va at Richmond	....	10 00

Manufacturing and Steam Coals.

Cumberland at Georgetown and Alexandria, Va	3 50@3 75	4 90
Cumberland, at Baltimore	3 65@3 80	5 10
Clearfield f.o.b. Canton, Baltimore	3 75@....	5 25
Rockhill Semi-Bituminous and Broad Top, at the mine, per 2,000 lb., 90, f. o. b. Greenwich, Philadelphia, per 2240 lb., $3 25@3 78, according to destination; at South Amboy, N.J., 4 50; New York, discharged.		
Clearfield and Allegheny, "Kittanning," "Sterling," "Sonman," and "Eureka," at the mines, per 2000 lb., 90; at Greenwich, Phil., per 2240 lb., 3 25@3 80, according to destination; f.o.b. South Amboy, N. J., 4 50; New York, discharged, 5.		

Foreign Gas Coals.

	Sterling.	Am. cur'cy.
Newcastle, at Newcastle-on-Tyne	9/6@11/	6 50@7 00
Liverpool House Orrel, at Liverpool	26/	13 00
Ince Hall Cannel "	42/	18 00
" Gas Cannel "	28/	13@14
Scotch Gas Cannel, at Glasgow, nominal,	25/	7 50
	Gold.	
Block House, at Cow Bay, N. S	2 00	4 75
Caledonia, at Port Caledonia	1 50	4 25
Glace Bay, at Glace Bay	1 50	4 25
Lingan, at Lingan Bay	1 75	....
Sydney, International and Reserve mines, at Sydney	2 00	5 50
Pictou, Albion & Vale mines, at Pictou.	2 25	5 75

Retail Prices in New York.

Anthracite.

Per 2000 lb.	Grate and Egg.	Stove.	Chestnut.
Pittston coal, in yard	$4 25	$4 50	$3 80
Lackawanna coal, in yard	4 20	4 50	3 80
Wilkes-Barre, delivered	5 00	5 30	4 60
Lehigh & Locust Mountain, del'd	5 50	5 50	5 00
Schuylkill Red Ash, del'd	6 00	6 00	5 50

The Cost of delivery for Pittston and Lackawanna coal ranges from 40 cts. to $1 10 per ton, according to distance from the yard.

Bituminous.

Liverpool House Orrel, delivered, per ton of 2000 lb	$18 00
Liverpool House Cannel " " "	22 00
American " " "	13 00
Cannelton Block, or splint, " " "	10 00
American Orrel " " "	11@14
Red Bank Cannel " " "	10 00
Cumberland " " "	7 00

Baltimore, Md. Oct. 9, 1876.

Reported by our Special Correspondent.

ANTHRACITE.

Wholesale or Trade Prices per 2240 lb.

Wilkes-Barre "Lee" or "Diamond," Pittston and Plymouth. White ash.	In cars at depot.	By boats afloat.
Lump and steamboat	$3 85	$3 55
Broken	3 85	3 55
Egg	3 85	3 55
Stove	4 35	4 05
Nut	3 85	3 55
Shamokin, (red or white ash), and "Boston," free burning white ash,		
Egg	4 10	3 80
Stove	4 35	4 05
Lykens Valley, red ash,		
Egg and stove	5 35	5 05

From wharf or yard, wholesale, 50@75c. additional.

By retail, all kinds and sizes, per 2240 lb. $5 00@7 50

BITUMINOUS.

George's Creek, Cumberland f. o. b. at Locust Point	3 75@4 00
West Virginia Gas f. o. b. at Locust Point	4 50
Youghiogheny Gas, f. o. b. at Locust Point	4 50
Swanton	4 00

Boston. Oct. 7, 1876.

THE market holds very steadily, the retail dealers having been sufficiently encouraged by the status of the wholesale trade to advance their prices 50 cents per ton. The New York papers, some of them, seem to think the last sales were a myth, but, so far as steamer coal is concerned, the better part of that in both sales comes to New England. One *bona fide* buyer took all the Lackawanna offered. The demand for cargoes of stove and egg is quite large, and sales by the agents here have been made during the week to cover a large amount. There is less pressing anxiety for deliveries, and the coal fleet just discharged has distributed a large quantity. The return of so many empty vessels to New York and Philadelphia, has given an easier turn to freights, and charters for vessels en route have been reported at 10c. under our quotations.

BITUMINOUS is selling in a steady way, with well sustained prices. The stocks held here are light.

FREIGHTS are easy at $1.50 from New York; $2@2.10 from Philadelphia; $1.45@1.50 from Baltimore, and $1.60 from Georgetown.—*Commercial Bulletin.*

Buffalo, N. Y. Oct. 8, 1876.

Reported by LEE & LOOMIS.

Deliv'red at	Elmira. Afloat.	Ithaca. Afloat.	Syracuse Afloat.	Rochester. Afloat	Rochester. ret. del.	Oswego f.o.b.
Grate	$3 80	$3 05	$3 20	$3 90	$5 15	$4 15
Egg	3 80	3 15	3 30	4 00	5 25	4 25
Stove	4 20	3 65	3 80	4 50	5 75	4 75
Nut	3 95	3 40	3 55	4 25	5 50	4 50

Delivered at	Erie. f.o.b.	Buffalo. Afloat.	Buffalo. f.o.b.	Buffalo. ret. del.
Grate	$4 65	$4 15	$4 65	$5 40
Egg	4 75	4 25	4 75	5 50
Stove	5 25	4 75	5 25	6 00
Nut	5 00	4 50	5 00	5 75

Chicago, Ill. Oct. 9, 1876.

Lackawanna Stove	$7 50
" Chestnut	7 25
" Grate and Egg	7 00
Erie and Brier Hill	5 50
Wilmington and Illinois	4 75@4 2,
Blossburgh	7 0.

Cincinnati, O. Oct. 9, 1876.

Reported by our Special Correspondent.

Per ton of 2000 lb.	Bush.	Ton.
Youghiogheny, or Pittsburgh, afloat	@6½c.	—
Pomeroy coal "	@5c.	—
Kanawha " "	7 c.	—
Cannel coal, according to quality "	11 @16c.	—

The following are the retail prices delivered

Youghiogheny	8c.	—
Pomeroy	8c.	—
Cannel	14@20c.	—
Kanawha	10c.	—
Anthracite, per ton		10 50
Coke, at yard	7c.	—
Coke, hard and soft, delivered	—@10c.	—

Cleveland, O. Oct. 9, 1876.

Specially reported by Messrs. LAMBIE & BATES.

Per ton of 2000 lb. f. o. b. vessels.

WHOLESALE.

	For vessels,	On cars.
Youghiogheny Gas Coal	$4 10	$4 00
Cannel	4 25	4 15
Blossburgh	$5 00	$5 00
Briar Hill, Block Coal	3 50	3 25
Straitsville Coal Co., lower vein	2 90	2 90
" " " whole "	2 80	2 80
Hocking Valley	2 90	2 90
Massillon	2 90	3 00
Tuscarawas Valley	2 50	2 50
Columbiana	2 50	2 50

CLEVELAND COAL EXCHANGE PRICES UNTIL FURTHER NOTICE.

	1 to 10 tons.	10 tons upw'd.
Brier Hill lump	$4 25	$4 00
" " nut	3 75	3 50
Massillon and Mineral Ridge lump	4 00	3 75
" " " " nut	3 75	3 50
Straitsville Lower Vein, Hocking & Shawnee, l'p.	3 00	3 35
" " " " nut	3 40	3 15
Del Carbo lump	3 75	3 50
" " nut	3 50	3 25
Rich Hill lump	3 00	3 35
" " nut	3 25	3 00
Maple Hill lump	3 50	3 25
" " nut	3 25	3 00
Columbiana, lump	3 25	3 00
" nut	2 75	2 50
Lacka'a., Wilkesbarre and Pittston egg and grate,	6 25	6 05
" " " stove	6 75	6 50
" " " chestnut	6 50	6 25

Lehigh to be $1 25 per ton higher.

All sales to be strictly cash with order or C. O. D.

Indianapolis, Ind. Oct. 9, 1876.

Specially reported by Messrs. COBB & BRANHAM.

Wholesale on board cars, and retail delivered to consumers.

Per ton of 2000 lb., bushel of 70 lb.

BITUMINOUS.

White River, per ton	$2 50	Peytona cannel, per ton.	5 75
Brazil Block, "	2 50	Indiana Cannel	4 50
Highland, grate, "	2 25	Hocking Valley	4 25
Block coal, nut, per car	18 00	Youghiogheny	4 50
Highland " "	18 00	Blossburg (smithing)	6 50
Block Slack "	17 00	Piedmont "	6 50
		Gas coke, per bushel	10

ANTHRACITE (Lackawanna and Wilkes-Barre.)

Broken	$8 35	Nut	8 50
Egg	8 35	Stove	8 75

Lehigh Anthracite.

Broken	9 75	Nut	9 50
Egg	9 75	Stove	10 00

Retail, per bushel, delivered.

Sand Creek	15c.	Block Nut, steam	8
White River	13	" Slack, "	7
Brazil Block	14	Peytona Cannel	28
Highland grate	13	Virginia "	27
Block Nut, domestic use.	12	Youghiogheny	20
Highland Nut, " "	12	Blossburg	26
" " steam	8	Piedmont	26

GAS COKE (measured.)

Crushed	15c.
Lump	12c.

ANTHRACITE.

Wilkes-Barre and Lackawanna (all sizes)	$9 75 per ton.
Lehigh, retail	$11 50 per ton,

Louisville, Ky. Oct. 9, 1876.

Specially reported by Messrs. BYRNE & SPEED.

There is a large supply of coal here. The wholesale sales are light, taking into consideration the low prices. The retail demand is good.

Please report our prices as follows;

WHOLESALE.

	per bushel		per bushel
Pittsburg	6½c.	Pine Hill	—
Raymond City	6½c.	Kentucky	7c.

RETAIL.

	per bushel		per bushel
Pittsburgh	10c.	Peytona Cannel	18c.
Raymond City	10c.	Buckeye "	
Pine Hill	13c.	City-made Coke	8c.
Kentucky	9c.	Anth., per ton,	$10 00 to 10 50
Screened Pittsburgh per load			$3 50
Screened Raymond City			2 50
Pine Hill (Kentucky)			2 25
Cannel			4 50
City-made Coke			4 00

Milwaukee, Wis. Oct. 9, 1876.

Specially reported by Messrs. R. P. ELMORE & Co.

Trade is quiet. Our prices for coal are:

Retail price per ton of 2000 lb.

Lehigh Lump	$ 9 00	Briar Hill, select	$7 00
Lehigh Prepared	9 50	Blossburgh	7 00
Lackawanna (all sizes)	8 50	Cannel	8 00
Pittston	8 50	Pittsburgh	6 50
Scranton	8 50	Steam coal	5 50

New Orleans, La. Oct. 2, 1876.

Reported by C. A. MILTENBERGER & Co.

We have an improvement to report in the demand for coal in this market, but at drooping prices. Stock is fair.

There were on hand, October 1, 167 boats, 9 barges, and 6 French creeks of Pittsburg coal, and 2 boats of St. Bernard coal. The consumption during September was

23 boats, 1 barge, and 1 French creek of Pittsburg coal, and 1 boat of St. Bernard.

Pittsburg coal, wholesale, by boat-load, per bbl	27@28c.
" steamboats, per bbl	40c.
" to manufacturers	45c.
" shipments, per hhd	$5 25
Anthracite, wholesale, per ton	8@8.50
" retail, "	12@13
Virginia Cannel, per bbl	80c.
Scotch " "	80c.
Mt. Carbon, wholesale, per bbl	...
" " retail, "	50c.
St. Bernard wholesale, per bbl	25c.
" steamboat	35c.
" retail, "	45c.

Pittston, Pa. Oct. 9, 1876.

Pennsylvania Coal Company's Coal in yard, ton of 2000 lb.

Retail.	
Lump, Egg and Stove	$2 25
Chestnut	2 00

Delivered, fifty cents per ton additional.

Richmond, Va. Oct. 9, 1876.

Specially reported by S. H. HAWES, Dealer in Coal.

Prices are now as follows:

Per ton of 2240 lb., f.o.b.

Kanawha Cannel	$9 00	New River Bituminous	$4 00
" semi-Cannel	4 00	Clover Hill Coal	3 50
Coalburgh Splint	4 00	James River Bitum	3 30
Lewiston "	4 00	" " Carbonite	5 00
Kanawha Gas coal	3 90		

San Francisco, Cal.

From the *Commercial Herald*, Oct. 5, 1876.

Imports from Jan. 1st to Oct. 1:

	tons.		tons.
Anthracite	10,346	Vancouver Island	76,747
Australian	94,645	Rocky Mountain	152
Coos Bay	29,636	Seattle	69,064
Cumberland	9,251	Bellingham Bay	16,395
English	58,009	Chili	2,076
Mt. Diablo	76,860		

The spot supply is large and prices continue to favor the buyer, partly owing to the great difficulty in securing storage in the city. The quantity of foreign en route is very great, and much of this is already under contract at low prices; but the cost of holding and other expenses of handling so bulky an article deters dealers from operating for a rise. In the interim the home product of coast mines is being reduced very materially, and the business altogether unsatisfactory to all concerned. Imports the last fortnight have not been so great as the fortnight previous; but in any view of the case the market is dull, flat, and unprofitable. English steam cannot be quoted at more than $7.25@7.50; Australian, $8@8.25; anthracite, $12@15. The receipts for the week include 1,550 tons Wellington per *W. H. Besse, Malay*, 1,090 tons Nanaimo, *City of Panama*, 585 tons ditto, *Premier*, 530 tons Coos Bay, *El Dorado*, 1,800 Seattle, *Lord Ashburton* from Dundee, with 1,140 Scotch, besides more or less California Mt. Diablo.

St. Louis. Oct. 9, 1876.

Reported by JAS. J. SYLVESTER, Secretary of the Anthracite Coal Association.

Retail prices, delivered.

ANTHRACITE.	per ton.
Lackawanna	$9 00@10 00
Wilkes-Barre	9 00@10 00
Schuylkill	9 00@10 00
Lehigh	11 00@12 00
BITUMINOUS.	
Blossburg	9 00
Pittsburg	4 50
Indiana Block	4 00
Big Meadow	3 00
Illinois Coals	2 50@3 00
Connellsville Coke	9 00

Toledo, Ohio. Oct. 8, 1876.

Specially reported by GOSLINE & BARBOUR.

We quote as follows for retail delivery:

Lackawanna lump	$6 75	Lehigh lump	$7 75
" egg	6 75	" egg	7 75
" stove	7 00	" stove	8 00
" chestnut	6 75	" chestnut	7 75
Soft Coal.			
Hocking lump	4 00	Brier Hill	5 75
" nut	4 00	Blossburg	8 00
Willow Bank lump	4 50	Cumberland	8 00
" " nut	4 00		

Montreal. Oct. 9, 1876.

Specially reported by Messrs. ROBERT C. ADAMS & Co.

Wholesale per ton of 2240 lb.

Scotch Steam	$4 25	Cape Breton Steam	$3 75
Pictou "	4 25	Newcastle Smiths	5 50

Anthracite at retail, per 2000 lb., delivered.

Egg	$6 25	Chestnut	6 25
Stove	6 75		

Hamilton, Ont. Oct. 9, 1876.

Specially reported by H. BARNARD, Dealer in Coal.

Grate	$5 75
Egg	5 75
Stove	6 00
Nut	5 75
Lehigh Lump	6 50
Smithing	6 00
Bituminous, retail	5 50
" steam	4 00
Coke	6 75

Rates of Transportation on Anthracite Coal to Tide Ports.

OFFICE OF THE PA. & N. Y. R R. Co.,
BETHLEHEM, Oct. 1st, 1876.

On and after this date the rate on coal for Buffalo, for Watkins, Ithaca, and Weedsport, for water shipment; Auburn, for New York Central Railroad; Sterling, for Lake Ontario Shore Railroad, and Fair Heaven will be $1.03 per gross ton, between Coxton and Waverly. On coal for Rochester, via Erie Railway, Salamanca and points west therefore, an additional charge of 10 cents per ton will be made to cover transhipment charges at Waverly.

ROBERT H. SAYRE, President.

Freights

Representing the latest actual charters up to Oct. 13, 1876.

Per ton of 2240 lb.

PORTS.	From Philadelphia.	From Baltimore.	From Georgetown.	From Elizabethport, Port Johnson, South Amboy, Hoboken and Weehawken.
Augusta, Me	....	....	....	....
Albany	....	....	....	....
Alexandria	....	....	....	....
Amesbury, Mass	....	....	....	1 75
Bangor, Me	....	....	....	1 50
Bath, Me	....	2 00	2 10	1 50
Baltimore	....	....	....	....
Boston, Mass	1 80@2 00	2 00	2 10	1 50
Bridgeport, Ct	1 15†	1 50	....	80
Bristol, R. I	1 60	....	....	1 00
Cambridgeport, Mass	2 00@2 10	....	...	1 50
Derby	....	....	....	....
Dighton	....	....	....	....
East Cambridge	2 00@2 10	....	....	1 50
Fall River	1 60	1 60	1 90	1 00
Hackensack	1 12†	....	....	....
Hallowell, Me	....	....	....	....
Hartford	1 75@2 00	....	....	1 00
Hoboken	†95	....	1 50	45
Hudson	1 10	....	....	....
Jersey City	†95	....	1 50	45
Lynn, Mass	....	....	....	†1 50
Middletown	1 75@2 00	....	....	1 15
Mystic	....	....	....	....
Newark	†96	....	....	....
New Bedford	1 75	1 60	....	1 15
Newburyport	2 00	2 15	2 20	1 70
New Haven	1 10†	1 50	....	80
New London	1 60	1 50	....	80
Newport	1 63	....	....	1 10
New York	†95	1 50	1 50	45
Norfolk	....	....	....	75
Norwalk	1 10†	....	....	80
Norwich	1 60	....	....	1 00
Pawtucket	1 75	....	....	‡1 10
Philadelphia	....	....	....	....
Portland	2 00@2 15	2 00	2 10	1 35
Portsmouth, N. H	2 00@2 10	2 15	2 10	1 70
Providence	1 60	1 50	1 85	1 10
Poughkeepsie, N. Y	1 10†	....	....	....
Rockport	....	....	....	....
Saco	....	....	....	....
Sag Harbor	....	....	....	....
Salem, Mass	2 10@2 15	2 10	....	1 50
Salisbury Pt., Mass	....	....	....	....
Stamford	1 10†	....	....	....
Stonington	....	....	....	....
Taunton	....	....	....	....
Troy	1 15†	....	....	....
Warren, R. I	....	....	....	1 10
Wareham	....	....	....	....
Washington	....	....	....	....
Weymouth	....	....	....	....
Wilmington, Del	....	....	....	....

* And discharging and towing. † And discharging. ‡ And towing. § 30. per bridge extra.

IRON MARKET REVIEW.

New York.

FRIDAY EVENING, Oct. 13, 1876.

American Pig.—We note sales of 1,500 tons of Thomas Iron Company's iron at our quotations, but outside of this we learn of no sales worthy of note. The inclination to put furnaces in blast appears to be growing. The Crane Company will put in one furnace, Messrs. FOWLER & Company the Uhler furnace, while there is a rumor that the Glendon Company will put in two. There is also a rumor that the Reading Company will blow out eight furnaces. This latter will have no influence on prices, as this company has been out of the market, while putting in furnaces under the present demand, which is but little, if any greater, than ruled a month ago, must certainly have a weakening effect. It is very probable, however, that iron will be made as cheaply this Winter as for several years to come, and some may be anticipating the better times which cannot be much farther off. We continue to quote for the best brands as follows: No. 1 foundry at $22; No. 2, $20; and forge, $19@20. For makes of iron not so well known, there is a weakening tendency.

Scotch Pig.—We note sales of 125 tons of Coltness in lots at $28, and 200 tons of Eglinton at $25.75. Prices have advanced in Glasgow during the past ten days from 3/ to 5/ per ton; but the advance has had no effect here. We quote Eglinton at $26; Glengarnock, $27; and Coltness, $28@$28.50.

Rails.—We are reported a sale of 1,500 tons of steel rails for Eastern delivery, and a lot of hypothecated iron rails, all on private terms. We continue to quote iron rails at mills at $36@$41, and steel at $52@54.

Old Rails are without business, and quoted at $21, nominal.

Scrap Iron.—We are reported a sale of 200 tons of wrought, ex-ship, at Philadelphia, at a private price. We quote at $26@$27 from yard.

Philadelphia Iron Trade.

Weekly report of the Philadelphia Iron Market, furnished by Messrs. JUSTICE, COX, JR., & Co., Iron Merchants, 333 Walnut Street, Philadelphia. Week ending Oct. 12, 1876.

The demand for pig continues in smaller lots than at our last, but distributed among trade that for some time has been doing little or nothing, showing a better feeling and a slow but steady improvement in the iron business of the country. The demand for No. 2 and Forge is quite large, the latter quite scarce and held with considerable firmness, with a tendency to higher prices. No. 1 is less in demand, but held firm at quotations. We report sales of about 1,000 tons Crane in lots. 100 tons No. 1 Chickies at $22.50; 200 tons Montgomery No. 2 at $20; 50 tons No. 1 and 2 St. Charles at quotations. We quote No. 1 $22 to $22.50; No. 2 $20 to $20.50; Gray Forge, $19 to $19 50. Favored brands of Gray Forge, $21 to 22. We hear of a prominent brand of forge iron on the Lehigh, being reduced in price two dollars per ton and about to blow in two furnaces, the price having been much above the prices ruling.

MANUFACTURED IRON continues dull in bars with the low prices quoted from the West. Skelp and sheet iron continues in demand and sales are made daily at astonishingly low figures. We quote Bars 2.2-10c. to 2.3-10c. per lb.

RAILS.—Nothing new to report. Iron are quoted $38 to $41 and Steel $52 to $55.

SCRAP.—Wrought is dull at $24 to $27; Cast, $14 to $19.

OLD RAILS $21 to $22.50.

Baltimore. Oct. 11, 1876.

Specially reported by Messrs. R. C. HOFFMAN & Co.

Below we quote prices of pig iron, with market dull.

Baltimore Charcoal	$30@34	Anthracite No. 3	$20@21 00
Virginia Charcoal	28@34	Mottled and White	17@19 00
Anthracite No. 1	24@25	Charcoal C B. Blooms	63@65 00
" No. 2	22@23	Refined Blooms	50@55 00

Boston. Oct. 7, 1876.

PIG is selling, as noted the past two weeks, in a very irregular way as to prices, but still the selling interest is working out a good deal of stock. There has been a sharp canvass of this section by leading New York and Philadelphia brands, and three cargoes are understood to have been sold at under $22 for prime No. 1 f. o. b. The furnaces are showing very little interest in gray forge, the scrap market offering better opportunities.

BAR holds a good fair jobbing demand, with prices sustained from $49 upward. In common iron a little more is doing, although the price, $40, is now where nothing can be replaced at the price. The mills are busy enough to have slightly advanced, and, as the jobbing stock of common runs down, $2 is very likely to be added to the selling price.—*Commercial Bulletin.*

Chattanooga, Tenn. Oct. 9, 1876.

Specially reported by J. F. JAMES, pig iron broker, etc., 233 Market Street.

No change to report in the condition of our market during the past week. Car-wheel iron being so slow of sale that the holders have decided on a slight reduction in prices. Below are corrected current prices on the usual four month's time.

Tenn. Ala. and Ga. Charcoal, No. 1 foundry	$20@ 21
" " " " No. 2 foundry	19@ 20
" " " " gray forge	16@ 17
" and Georgia coke, No. 1 foundry	18@ 19
" " " " No. 2 foundry	17@ 18
" " " " gray forge	15@ 16
White and Mottled	14@ 5
Tennessee and Georgia cold-blast car wheel	21@ :2
Alabama " "	21@ :2
Old Rails	cash 20 50
Cast Scrap	" 13
Wrought Scrap	" 18@ —

Cleveland, Ohio. Oct. 9, 1876.

Messrs. C. E. BINGHAM & Co., quote as follows:

Per gross ton, on four months' time. Subject to change in market. Discount for cash 4 per cent.

FOUNDRY IRON.

No. 1, Lake Superior Charcoal	27 00@....
No. 2, " " "	26 00@....
No. 1, Anthracite	25 00@....
No 2, "	23 00@....
No. 1, Bituminous	24 50@....
No. 2, "	23 00@....
American Scotch, No. 1, Cherry Valley	@....
" " B—1, " "	@....
" " No. 2, " "	@....
No. 1, Massillon	25 50@....
B—1, "	24 00@....
No. 2, "	21 00@....

CAR WHEEL AND MALLEABLE IRON.

No. 3 Lake Superior Charcoal	27 00@....
No. 4 " " "	27 50@....
Nos. 5 and 6 "	27 00@....

BESSEMER IRON.

Nos. 1 and 2 Lake Superior Charcoal	27 00@....

FORGE IRON.

No. 1, Gray	22 00@....
White and Mottled	21 00@....

Cincinnati. Oct. 9, 1876.

Specially reported by Messrs. TRABER & AUBERY, commission merchants for the sale of pig iron, blooms, ore, etc.

The demand is fair, and prices are firm at quotations.

CHARCOAL.

Hanging Rock, No. 1 Foundry	$24 00@25 00—4 mos
" No 2, "	23 00@ ....—4 mos
" Mill	20 00@ ....—4 mos
Tennessee, No. 1, Foundry	23 00@ ....—4 mos
Tennessee, No. 2, "	22 00@ ....—4 mos
" Mill	20 00@21 00—4 mos
Missouri, No. 1, Foundry	.... @ ....—4 mos

STONE COAL.			
Ohio, No. 1, Foundry	22 00@22 50	—4 mos	
" No. 2, "	20 50@21 00	—4 mos	
Ohio Mill	19 00@20 00	—4 mos	
Missouri, No. 1 Foundry	25 00@	—4 mos	
" No. 2, "	24 00@	—4 mos	
" Mill	23 00@	—4 mos	
CAR-WHEEL.			
Hanging Rock, C. B	40 00@43 00	—4 mos	
Tennessee "	25 00@32 00	—4 mos	
Missouri "	31 00@35 00	—4 mos	
Alabama "	25 00@32 00	—4 mos	
BLOOMS.			
Charcoal	60 00@ 75 00	—cash	
SCRAP IRON.			
Cast	50c.@ 85	—cash	
Wrought	1 00@1 40	—cash	

Louisville. Oct. 10, 1876.

Specially reported by Messrs. GEORGE H. HULL & Co.

The market is without change in tone or price.

The usual time, four months, allowed on quotations below.

HOT BLAST—CHARCOAL.		
No. 1 Foundry, from Hanging Rock Ores	$23 00@25 00	
No. 2 " " "	21 00@22 00	
No. 1, Mill, from " "	19 00@20 00	
No. 1. Foundry, from Alabama, Georgia and Tennessee ores	21 00@22 00	
No. 2, Foundry, from Ala., Geor'a and Tenn. ores	20 00@21 00	
No. 1, Mill, from " " " "	19 00@20 00	
HOT BLAST—STONE COAL AND COKE.		
No. 1, Foundry, from Hanging Rock Ores	21 00@23 00	
No. 2, " " " "	20 00@21 00	
No. 1, Mill, " " " "	19 00@20 00	
No. 1, Foundry, from Ala. Ga. and Tenn. Ores.	20 00@22 00	
No. 2, " " " "	19 00@20 00	
No. 1, Mill, " " " "	18 00@19 00	
No. 1 Foundry, from Missouri Ores	—— @ ——	
No. 2 " " " "	—— @ ——	
No. 1 Mill, from Missouri Ores	23 00@24 00	
COLD BLAST—CHARCOAL.		
Car Wheel from Hanging Rock Ores	35 00@43 00	
" " Tennessee "	25 00@30 00	
" " Alabama and Georgia Ores	28 00@40 00	
" " Kentucky Ores	28 00@42 00	

St. Louis. Oct. 10, 1876.

Specially reported by Messrs. SPOONER & COLLINS, Commission Agents for all kinds of Iron.

There seems to be a better feeling among our iron men here. The demand is very good, and prices firm, with a slight advance on some special brands. Mill irons are very scarce.

Mo. Stone Coal No. 1 Fy.	$25@26	Massillon iron, A No 1	29@30
" " " 2 "	23@24	" " B "	1.31@—
" " Gray Mill,	22½@23	" "	2.28@—
" Charcoal No. 1, Fy.	23@24	Cold Bl. Car Wheel, Mo.	30@33
" " " 2, "	22@23	" " " Tenn.	30@33
" " Gray Mill,	22@23	" " " Ala.	30@33
Tenn. " No. 1, Fdy	23@24	" " " H. R.	33@35
" " " 2, "	22@23	Mo. Charcoal Blooms	50@65
" "Gray Mill	22@23	" Scrap "	45@55
Va. Coke, No. 1, Fdy.	24@25	" " hammered Billets	75@80
" " " 2, "	23@24	Assorted Bar Iron	2 50, 60 days
" "Gray Mill,	21@23	No. 1 Wrought Scrap	90c. cwt.
H. R. Char. No. 1, Fdy.	25@26	Heavy cast "	70 "
" " " 2, "	24@25	Light "	50 "
" " Gray Mill,	24@25		

San Francisco, Cal.

From the *Commercial Herald*, Oct. 5, 1876.

We have now to note sales of 500 boxes Terne roofing plate, 14x20, at $8.25; 2,000 lb. Sydney block tin at 18½c. The steamer *Salvador* for Panama carried en route to New York, 173,558 lb. pig lead. The stock of pig iron, both American and English, is large, and prices even of No. 1 Scotch, and all other sorts more or less nominal—say $30. Tin plate is in large stock We quote I.C. coke, $7.50; I.C. charcoal, $8.50@9; I.X. ditto, $10.50 @11; roofing plate, $8.25.

Montreal. Oct. 3, 1876.

We continue to quote: Pig iron, Eglinton and Clyde; $18.50@$19; Carnbroe $19.@$19.50; Summerlee and Glengarnock, $19.50@$20; Calder and Gartsherrie, $20 @$20.50; Coltness, $21@$21.50; Hematite, $30. Bar, per 100 lb., Scotch and Staffordshire, $2@2.10; best do., $2.25@2.35. Swedes and Norway, $4.75@5.50; Low Moor and Bowling, $6@7.—*Monetary Times.*

METALS.

NEW YORK, FRIDAY EVENING, Oct. 13, 1876.

THE business of the week has been quite limited in all articles on this list. Prices in this market show but little change, while in London there has been an upward tendency to several articles.

Gold Coin.—During the week under review, the price of gold has ranged from 109¼ to 108⅞, and closed at 109.

Bullion.—Silver is higher than at the date of our last. Quotations are as follows: In London, 52½d.; San Francisco, 10 per cent. discount; and in this city 114¾@ 115 per oz. Gold bars remain at par @ ¼ per cent. premium.

Copper.—We note sales of about 300,000 lb. at 21c. which is firmly asked at the close. Chili bars in London have advanced to £76 10/, and best selected to £81

Messrs. SANDERS Brothers of London, under date of September 28, say of copper:

"Since we last wrote, our copper market remained pretty stationary till the news arrived of the charters for the second half of August, which were 3,800 tons. Generally speaking, it was felt that a rather lower range of prices should ensue, but Chili copper, especially just now, is very strongly held, and is in few hands (more than half of it being in one hand), so the expected drop did not come, and when charters were announced for the first half of September, viz., 2,300 tons, an advance of 10/ was quickly established, and the market hardened up to yesterday, when the Wallaroo sale took place. As this went higher than seems to have been generally anticipated, we close with a strong market at the above quotations. There is a scarcity of ores and regulus, and smelters have to work a good deal on bars. They are, therefore, very dependent upon the views of the present holders of Chili produce. Consumers generally are only moderately off for copper, and smelters stocks are small, although the amount of business transacted during the past month has not been unusually heavy. The total figures on the 1st inst were 36,138 tons, against 36,768 tons on the 1st of August, showing a decrease of 630 tons."

Tin.—Straits has advanced to £73 10/@£74. There is but very little business doing here. We quote Straits at 17¼@17⅛c.; L. & F., 16¾c.@17c.; refined, 16¾c.@ 17c.; and Banca, at 19¼c.@20c., prices all gold.

Tin Plates.—There is very little business doing in these. We quote as follows, in gold, per box: Charcoal tins $7@7.25, and ternes; $6.37½@$6.50; coke tins, $6@$6.12½ and ternes, $5.62½@$5.75.

Messrs. ROBERT CROOKS & Co., of Liverpool, under date of September 28, 1876, say of tin plates: "Buying continues to be of the most limited description, and some makers are now making considerable concessions, and great efforts to obtain orders, but without much effect. This action is only taken by a few manufacturers, several having still work on hand to last for two months more; while many others are independent enough to decline sales at present rates. The weaker works, too, find considerable difficulty now in obtaining credit sufficient to procure raw material. This necessarily hampers their output. At the same time, if demand does not improve, we will have, though probably only for a small number of brands, lower prices."

Lead.—There has been but very little business done during the past week. The market closes at 6½c. currency, for ordinary domestic here, while in St. Louis, Missouri soft is quoted at 6c. currency.

Spelter and Zinc.—Of foreign spelter 25 tons have been sold, at 7c. gold. Domestic is quoted at 6¾c. currency, and is very quiet. Domestic sheet zinc is quoted at 8¾c. currency, and foreign at 8¼c. gold.

Antimony is very dull of sale at 14¾c. gold.

Quicksilver.—In San Francisco this article is quoted at 42c.@44c. gold, per lb.; in this city, 49c.@50c.; and in London, £8 per flask.

The San Francisco *Commercial Herald*, Oct. 5, says of quicksilver: "The market has been without animation for a fortnight past. Sales, however, to a limited extent are daily made at 42¼c.@44c. for export The steamer *Salvador* for Panama, carried en route for New York, 160 flasks; the steamer *City of Peking*, for Hongkong, carried 210 flasks. We note sales of 220 flasks (2 car-loads) for shipment to New York."

THE SALT LAKE CITY SILVER ORE MARKET.

MR. J. B. MEADER, assayer, gives the following statement of the ore and metal market for the week ending Oct. 7th.

Argentiferous Lead (Base Bullion).—$70 per ton for lead; $1.16 per oz. for silver; $20 per oz. for gold. The above quotation for silver is based upon a silver contents in the lead of 80 to 120 oz. per ton of 2,000 lb.

Argentiferous Lead Ores.—From 90c. to $1 per oz. for the silver contained therein, based upon a standard of 40 per cent. lead, each unit above 40 per cent. 50 cents per unit added. Each unit below 40 per cent. 50 cents deducted. Extreme prices, and only for most desirable carbonate ores, free from zinc, copper, and antimony. Ores containing zinc—For each unit of zinc above 5 per cent., deduct the value of 1 oz. of silver. Ores with a lime or ferruginous gangue, subject to higher rates. Copper, antimony, zinc, and iron pyrites in all the above ores objectionable.

Lead is weaker; silver ruled through the week at 1.13 to 1.14⅛, purchases being made on Government account. Not much change to note in the market here.

Shipments of base bullion for month of September	3,634,298 lb.
Shipments of base bullion for 8 months	25,332,381 "
Total for 9 months	28,966,679 lb.
Ore shipments for Sept. reduced to lead	667,343
Ore shipments for 8 months reduced to lead	2,991,151
	3,659,294 lb.
Total production of lead for 9 months	32,625,993 lb.

FINANCIAL.

New York Stocks.

NEW YORK, FRIDAY EVENING, Oct. 13, 1876.

A STEADIER feeling is manifested throughout the dealings in this market during the past week; quotations however are generally lower, and close to-day at nearly the lowest point of the week, something over 280,000 shares represent the transactions.

Delaware, Lackawanna and Western Railroad, 195,000 shares of this stock have changed hands between 68⅞ and 73¾ closing at 69¼. The men employed in the car and locomotive shops at Scranton, Pa., refuse to accept the reduction of ten per centum in their wages, and a serious strike is threatened. The conductors and brakemen have held a meeting and decided to be governed by the answer sent to the men at the railroad shop. It is thought that the train men will submit to the reduction in wages. The new tunnel of this Company will be opened in a few weeks for travel. The actual gain in distance is 3,200 feet, or six tenths of a mile; the virtual gain in time is about five miles.

New Jersey Central Railroad.—Stock closes down to 33¼, a decline of over 7 per cent. from the highest point of the week, and 5 per cent. below the closing price in our last. Sales for the week are over 78,000 shares.

The changes which have been made in the management of New Jersey Central have not materially strengthened the stock. There seems to be an impression afloat that the Presidency of Mr. KNIGHT was urged and accepted more for stock speculation purposes than with any well-founded belief that he could carry the company through its difficulties. Indeed, there are not wanting those who think this respectable old concern is to be handed over to the Philistines to go through something of the same course as Erie, ending in a Receivership. The Directors have accepted the resignation of Colonel R. E. RICKER, as Superintendent of the road, to take effect on the 1st of November. His successor will be Colonel James MOORE, at present Consulting Engineer of the line.

Delaware and Hudson Canal Company.—This stock is somewhat lower, the final price being 65¼ and the extreme quotations of the week 69¾@65. Sales aggregate about 7,000 shares.

We last week published in this column an extract from the London *Mining Journal*, which was subsequently copied by several of our city dailies, and in which it appears our authority was in error. The extract was as follows:

"The Scottish-American Investment Company announce the issue of 1,000 10 per cent. first consolidated mortgage bonds, of $1 000 each, of the Albany and Susquehanna Railroad Company, principal and interest guaranteed by the Delaware and Hudson Canal Company."

As the statement that the company was in the market, borrowing at 10 per cent., seemed to us quite serious, as well as important, we applied, before publishing it, at the office of the company, for an explanation, and were told that they "they had nothing to say about it," or words to that effect.

Its publication naturally attracted much attention, and some unfriendly comment. The following letter, which we have received from the Treasurer of the Company, explains satisfactorily the matter, and shows that the statement, "10 per cent.," was an error of our English contemporary.

DELAWARE AND HUDSON CANAL CO.,
TREASURY DEPARTMENT,
NEW YORK, 12th October, 1876.

DEAR SIR—I beg to assure you that we know nothing whatever of any such company as the "Scottish-American Investment Company," nor of any bonds which that company may be offering for sale.

If, as stated, in the London *Mining Journal*, they are the "first consolidated mortgage bonds of the Albany and Susquehanna Railroad Company," then they are, probably, part of a lot of seven per cent. bonds issued to this company in April last, of which $1,500,000 were, at that time, sold to different parties in this city. These having been delivered and paid for, of course we have no further interest in them; the purchasers have, it seems to me, a perfect right to dispose of them as, and when, and to whom they please.

The first consolidated mortgage bonds above referred to are guaranteed, principal and interest, by this company.

Yours very truly,
J. C. HARTT, Treast.

The Hampshire and Baltimore Coal Company will hold its annual meeting in Baltimore on the 19th inst.

Geo. F. Blake Pump Manufacturing Company.—We note a recent auction sale in Boston of 20 shares of the stock of this company at 30⅞ per cent.

Sussex Railroad.—This road is now doing a considerable business in iron ore from the mines near Franklin Furnace, N. J., which is carried to Waterloo and thence over the Delaware, Lackawanna and Western to the Scranton furnaces. The ore is carried in coal cars, which thus secure what they very seldom have, a return load.

Bonds have sold to the extent of $260,000 and are, generally lower.

Quotations and Sales of Stocks and Bonds,

For the week ending Oct. 13, 1876.

STOCKS.

	Highest	Lowest	Closing	Shares sold.
Pennsylvania Coal Co	—	—	220	9
Consolidation Coal Co	30	30	31⅛	58
Spring Mt. Coal Co	—	—	*55	—
American Coal Co	—	—	*54	—
Maryland Coal Co	—	—	*10	—
Del., Lack., and West. RR. Co	73¾	68¾	69¾	194,862
New Jersey Central RR. Co	40½	33¼	33¼	78,252
Delaware and Hudson Canal Co	69¾	65	65¼	7,197
Quicksilver Mining Co. pref'd	—	—	17	—
" " " Common	—	—	11⅜	—
Mariposa Land & Min. Co. pref'd	5	4⅜	4⅞	400
St. Louis & Iron Mountain RR	17¾	17¼	17¼	160
Total Shares sold				280,838
Sales for the week previous				736,244
Decrease				455,406

* Nominal.

BONDS.

	Inter'st	Sales.	Price.
Del., Lack. & West. 2d M.....	M. & S.	2,000	106¼@110
" " " 7's Con'ble	J. & D.	....	.... @100
Cent'l RR. of N.J., 1st M., New	F. & A.	24,000	107⅞@110
" " " 1st Cons..	.....	68,000	86 @ 90½
" " " Convert'le	M. & N.	56,000	85 @ 90½
Lehigh & W.-B'e, Con. Guar'd.	.....	70,000	65 @ 74
Am. Dock & Imp. Mt. Bonds..	J. & J.	2,000	84 @ 85
Del. & Hud. Can., 1st M., 1891	.....	6,000	107½@108
" " " 1884	.. ....	.....	.... @103¾
" " " 1877	.....	.....	.... @103⅜
" " " Coup. 7's, 1894	.....	25,000	95 @ 98
" " " Reg'd 7's, 1804	.....	.....	.... @ ....
St. L. & Iron Mountain, 1st M	F. & A.	1,000	.... @ 99½
" " " 2d M	M. & N	1,000	.... @ 70
Chesapeake & Ohio 6's, 1st M..	.....	6,000	.... @ 24
" " Ex. Coupon	.....	.....	.... @ 20
Mariposa Gold Loan con. 7s....	.....	.....	.... @100⅝
Total sales.....		$261,000	

Closing quotations, in the absence of sales, represent the latest prices bid.

Philadelphia Stocks.

PHILADELPHIA, Thursday Evening, Oct. 12, 1876.

The business transacted in coal shares in this market during the week just closed has been moderate, and with a single exception we lower the quotations. The sales for the week show a falling off of over 50,000 shares, the aggregate amounting to nearly 128,000 shares. Fluctuations have not been so marked as last week, no difference of more than 3 points in the most extreme prices being observed.

Pennsylvania Railroad.—44,560 shares of this stock have changed hands between 48¼ and 47⅞ closing ¼ above the lower figure. The passenger earnings of this company for the month of September alone amounted to over $1,000,000, the official report showing a total of 1,009 440 passengers carried.

Reading Railroad.—This stock is lower. Sales for the week aggregate nearly 69,000 shares, between 24½ and 27¼ as the extreme prices, closing at 24¾, equal to 49½ per cent. of its par value. There is much uneasiness felt concerning this company, and many rumors of changes in its *personelle*. The company passed through a crisis last week, and its friends claim for it that it is safe at least for months to come.

"BOSTON, October 13.—The maturing obligations of the Reading Railroad here to-day were duly met on presentation."

We insert the above as contradicting rumors which were circulated to depress the coal stocks at the New York market. The amount of this paper was about $300,000.

Lehigh Valley Railroad.—This stock has slightly advanced, the highest quotation for the week being $50 per share or par. The closing price is one point below this, which is an advance of 1⅛ per cent.

Lehigh Coal and Navigation Company.—Over 12,000 shares of this stock have changed hands at from 31⅞ to 33¼, closing at 32¾, a slight decline from our last.

Cambria Iron Company.—25 shares of this stock were sold at auction during the week, at $15 per share.

Pennsylvania Salt Manufacturing Company.—We note recent auction sale of 64 shares of this stock, at $67.75 per share.

Minersville Coal and Iron Company.—15,000 of the 1st mortgage bonds of this company were sold at auction during the week, at one per cent.

Quotations and Sales of Stocks and Bonds.

For the week ending Oct. 12, 1876.

STOCKS.

	Highest	Lowest	Closing	Shr s
Lehigh Valley RR. Co.....	50	47½	49	2,754
Pennsylvania RR.	48½	47¾	47⅞	44,560
Reading RR.	27½	24½	24¾	68,498
Lehigh Coal and Nav. Co.....	33¼	31⅞	32⅜	12,100
Penn. Canal.....	—	—	*9	—
Buck Mountain Coal Co.....	—	—	*25	—
Fulton Coal Co.....	—	—	*3½	—
Locust Mountain Coal Co	—	—	—	—
Westmoreland Coal Co	—	—	*85	—
St. Nicholas Coal Co.....	—	—	*1	—
Cambria Iron Co.....	—	—	*16	—
Crane Iron Co.....	—	—	*25	—
Emaus Iron Co	—	—	—	—
Pennsylvania Salt Manufact. Co...	—	—	68	—
Total shares sold.....				127,912
Sales for the week previous.....				177,988
Decrease.....				50,076

* These quotations are nominal.

BONDS.

	Sales.	Price
H. and B. T. RR. 1st mortgage, 7s.....	$ —	— @107
" " " 2d "	—	— @102
" " " 3d " cons	—	— @ 38
Lehigh Valley RR. Con. mtg. 6s.....	10,000	99 @ 99¾
" " " 7s, 1910.....	24,000	110⅜@111
" " " 6s Reg.....	—	108½@—
" " " 1st M. 6s coup.....	—	— @107
Pennsylvania RR., 1st mtge. 6s.....	9,000	106⅛@106¾
" " gen. " con. 1910...	10,000	106⅛@107
" " gen. " 6s, reg.....	4,000	— @105½
" " Cons. M. 6s reg.....	2,000	— @100
Phil. & Reading RR. Con. M. 7s Reg....	2,000	— @102⅛
" " " G. M. 7s, coup.....	6,000	102 @103
" " " Gen. M. 7s reg.	1,000	— @103
" " new convertible 7s... ..	32,800	80 @ 85
" " 6s 44-80.....	3,500	— @102
" " Cons M. 7s coup.....	18,000	102 @103
" " debenture 6s.....	5,000	65 @ 69
Phil. & Reading C. & I. Co. Deb. 7s.....	17,000	70 @ 85
" " Tamaqua & Swatara tract.	—	— @ 80
Lehigh Coal & Nav. Co., 6s '84.....	7,500	99¼@100½
" " " RR. 6s, '97.....	5,800	100 @100¾
" " " 6s '77.....	16,000	— @ 94
" " " 6s gold loan...	3,500	97½@ 98
" " " Conv. gold loan....	500	— @102
Penn. Canal, 6s.....	—	— @ 69¾
Penn. and N. Y. Canal, 7s.....	20,000	110¾@110¾
Ches. and Del. Canal, 6s.....	—	— @ 85
Susquehanna Canal, 6s.....	—	— @ 70
Delaware Division Canal, 6s.....	—	— @—
Susquehanna Coal Co. 6s.....	—	— @ 77
Buck. Mount Coal Co. 6s.....	—	— @—
Penn. Gas Coal Co. 6s.....	—	— @—
Honeybrook Coal Co. 7s.....	—	— @—
Total amount of sales.....	$198,600	

Closing quotations, in the absence of sales, represent the latest prices bid.

Gold and Silver Stocks.

AMERICAN MINING BOARD.

NEW YORK, FRIDAY EVENING, Oct. 13, 1876.

THE sales of the American Mining Stock Board for the past week, aggregate 31,020 shares, against 20,035 shares as sold during the business of the five days previous. With but one or two unimportant exceptions the list is decidedly lower, the Bonanza stocks being no exception, though they have declared dividends amounting to $2,160,000 for the two companies, and a September product of $2,156,812, of which amount the Consolidated Virginia Mining Company contributed $865,813. About one-half of this product was in gold. The October output, it is anticipated, will greatly exceed this. We give below very full information concerning the condition of a number of the mines, taken from our latest exchanges.

Sutro Tunnel.—Face of heading in hard porphyry with streaks of quartz and clay. Total length of tunnel on the 5th inst., 14 483 feet.

Caledonia.—Sinking the main shaft is going forward at a fair rate of speed, the rock in the bottom still being quite hard and the flow of water strong. The pumps are kept steadily running. At the 1,150-feet station a drift has been started northward, for the double purpose of prospecting the ore vein in that direction, and making a connection with the south drift on the 1,200-feet level of the Overman for air purposes.

Crown Point.—The main incline is down 140 feet below the 1,700-feet level. The main south drift on the 1,700-feet level has reached a point about 30 feet directly east of the combination pump-shaft on the Belcher line. The drift was run east of the shaft purposely to give room for the large water tanks required at that point This connection will be completed as soon as the tanks are in place for the reception of the water. The joint pumping machinery on the south line of the mine started up on the 1st inst., and works with the utmost perfection.

Gould and Curry.—The repairs to the main shaft are steadily progressing. The shaft is now in good working condition to within about 400 feet of the bottom. The main incline has been cleaned out and repaired to the bottom, a distance of 85 feet below the 1,700-feet level. The flood of water in the bottom which formerly resisted all efforts to drain it has disappeared, and the bottom of the incline is now perfectly dry. The water has evidently been drained by either the C. and C. or Savage shafts. On the 1,700-feet level a crosscut is now being run east from the shaft to cut the ledge. The main south drift on the 1.700-feet level is steadily advancing, the face still in favorable ledge matter.

Justice.—Daily yield, 150 tons of ore The ore stopes are looking splendidly and yielding good ore. The mills are all kept steadily running on ore from the mine, and the yield of bullion is steadily on the increase. The crosscuts from the main south drift on the 800-feet level show no change of value for the week. The main south drift on the 1,000-feet level is showing much better, and the chances are that it will soon cut a continuation of the rich ore body found on the levels above. The flow of water at the bottom of the shaft is still very strong and greatly impedes the progress of the work at that point. The condition of the mine for extracting ore and driving the developments on the lower levels is being greatly improved.

Yellow Jacket.—The main south drift on the 1,740-feet level made the connection with the north drift on the 1,700-feet level of the Crown Point Mine on the 2d inst. This connection has greatly cooled and benefitted the main incline and the 1,740-feet station. On the 2,040-feet level a drift west has been run a distance of 110 feet in very favorable ground. This drift is directly opposite the east crosscut, which is again steadily advancing. Air pipes are being put in on the 1,940-feet level, preparatory to drifting northward at that point to connect with the 2,135-feet level of the Imperial Mine.

Savage.—The pumping machinery is doing splendid work, and, assisted by the Hale & Norcross pumps, had reduced the water over 200 feet up to the 3d inst., when a fresh flood of water poured into the shaft, causing a rise of 60 feet in less than 36 hours in the main shaft. The rise has, however, been again overcome, and the water is now being held in check by the pumps, with every prospect of soon reducing it to the former level.

Consolidated Virginia.—Daily yield, 400 tons of ore, keeping the mills steadily crushing. The ore breasts on the 1,400-feet level are yielding richer ores than for some time past, and are looking splendidly. This ore is east of any that has yet been taken from that level. On the 1,550-feet level the ore stopes are yielding richly. The ore and bullion productions of the mine are again steadily on the increase. The mine is in splendid working condition throughout, and it will not be long before the old standard of $2,000,000 per month of bullion will be reached. The new pan mill is being tested and put in order for regular work. It will start up regularly about the 8th of this month. Day before yesterday the diamond drills on the 1.700-feet level, designed to penetrate to the bottom of the south winze and drain the water, were again started up. The air pipes, however, proved defective, obliging the entire suspension of the work until new pipes can be inserted, which is being done as rapidly as possible. A large supply of reserve ore is being hauled to the Sacramento and Occidental mills, to guard against any delay that may be occasioned by the storms and snows of Winter. The dividend, declared on the 4th inst., makes the thirtieth consecutive monthly dividend paid by the mine, the whole aggregating $22,680,000 and the appearances warrant the belief that it is good for almost as many more of the same amounts.

California.—Daily yield, 550 tons of ore, keeping the mills crushing up to their capacities. The ore stopes on the 1,500-feet level are looking finely, and are yielding the richest character of ores. The main south drift on the 1,600-feet level, running through the center of the ledge, has advanced 18 feet during the week, the face still being in ore equal to any that has yet been developed in the mine. Cross-cuts are now being run at different points on the 1,400-feet level, which are opening up ore of a much richer character than has before been developed. The yield of bullion for the month of September will not fall much short of $2,000,000. The mine was never showing better, or in a more prosperous condition than at present. Sinking the C. and C. shaft is progressing at the rate of 12 feet per week. All the blasting, and the entire extraction of the rock from the bottom of the shaft, has to be done under water at a very great disadvantage. Every blast discharged brings a fresh flood of water, which keeps the pumps steadily running at the rate of ten strokes per minute. The work has been prosecuted in this manner for the last 140 feet. The shaft is now down 140 feet below the 1,500-feet station.—*Gold Hill News*, October 5th, 1876.

This company has declared a dividend of $2 per share, payable on the 16th inst.

Bank of California.—On the 3d inst., the stockholders of this institution held their annual meeting in San Francisco, when the following were elected as the Board of Directors for the ensuing twelve months: D. O. MILLS, THOMAS BELL, WILLIAM SHARON, WILLIAM ALVORD, GEORGE H. HOWARD, E. J. BALDWIN, JAMES R. KEENE, ROBERT F. MORROW, CHARLES MAYNE HORACE W. CARPENTIER, and CALVIN PAIGE. During the past year about $7,500,000 have been collected on old accounts due the bank, and $4,000,000 of liabilities have been liquidated.

The Nevada Bank of San Francisco at their annual meeting on the 11th inst., re-elected the old officers, and a proposition to increase the capital from five to ten millions was unanimously carried. Shortly afterward FLOOD & O'BRIEN drew their check for the full amount of the increase.

The Manhattan Silver Mining Company of Nevada, has declared a dividend of $1 per share, equal to $50,000 from the September earnings, which amounted to $131,000.

The Merrimac Silver Mine has crosscuts or levels of a combined length of about 1,300 feet. They are at the depth of 37, 60, 100, 150, 200, and 220 feet, and the work is now progressing faster than ever, some 80 hands being employed, as the company is encouraged by richer finds, or more valuable ore. The product of vein matter is about 20 tons a day, which is concentrated to three or four tons, worth $120 per ton. Smelting works are soon to be added, which will make its machinery full and of the most approved patterns. The recent dividend of $1 per share, equal to $5,000, paid by this company on the 10 inst. was the first, and was announced as a monthly dividend.

The Nacooche Gold Mining Company will hold its annual meeting in New York, on the 26th inst.

Copper Stocks.

Specially reported by Messrs. WILSON W. FAY & Co., Bankers and Brokers, Room 7 Traveller Building, 31 State Street, Boston.

BOSTON, THURSDAY EVENING, Oct. 12, 1876.

The market closes to-night, a little off from the best prices of the week. It is reported that the Silver Islet Silver Company is to re-organize, and levy an assessment of 50c. per share, and reduce the capital stock three-fifths. About one year ago this stock was selling in the neighborhood of $30 per share. Allouez is very dull, hardly a sale being made since the removal of the company's office to New York. The silver stocks still take the lion's share of attention, although the market is not quite so animated on them as it was one week ago. Calumet is selling at the highest price it has ever attained, and parties who claim to know, predict it will touch $200 before long. Quincy is also very strong, and $50 is the figure now talked. If copper (on which of course, the value of these mines are based) advances to 23c., which it is not unlikely it will do after the close of navigation, we look for a strong bull movement in all the producing mines, and the little ones will be likely to follow in their wake.

Copper Products for September are reported as follows:

Calumet and Hecla (about).....	1,145 tons.
Quincy (about)	156 "
Osceola	105 "

Gas Stocks.

NEW YORK, FRIDAY EVENING, Oct. 13, 1876.

The stocks of the Brooklyn companies are moderately firm with but very few transactions reported to us. No change is noticeable in the New York quotations.

The Chicago Gas Difficulty.—The Committee on Gas held a meeting on the 6th inst., and heard the stories of several oil men who wish to contract to furnish the West side with lamps to succeed the gas lamps at present in use, and decided to recommend to the Council that permission be granted to each bidder to erect, at his own expense, twenty-five lamps on West Madison Street, and test them for ten days. The proposition of the People's Gas Light and Coke Company to furnish gas at $2 per

1,000 feet, and allow the use of three-feet burners, was laid on the table to await the result of the experiments with oil and gasoline.

Quincy, Ill., Gas Proposals.—The City Comptroller advertises that he will receive proposals until the 2d day of December, 1876, to supply the City of Quincy for a term of 25 years, from the 16th day of May, 1878, with a first-rate quality of illuminating gas, both for public and private consumption, the party contracting to have the exclusive right of supplying all gas to be used in the city, public and private, during the term of 25 years. The present requirements are a supply for 690 street lamps, and the average demand for private consumption is about 30,000 feet every 24 hours. The public lamps must be kept burning from twilight in the evening till dawn of day in the morning. The bids should state the price for gas supply, and also the price for lighting, cleaning, and keeping in repair the street lamps, and also the price per 1,000 feet to be paid by private consumers.

San Francisco Gas Company.—We note a recent sale of 200 shares of the stock of this company at $105 per share.

National Gas Company of Philadelphia.—We note a recent auction sale of $2,000 of the 6 per cent bonds of this company at 96 per cent.

The following list of Companies in New York and vicinity are corrected weekly by GEORGE H. PRENTISS, Broker and Dealer in Gas Stocks, No. 30 Broad st., N. Y.

Companies in New York and Vicinity	Cap. Stk.	Par.	last Dividend	When Paid.	Bid.	Askd.
			pr.c			
Mutual, N. Y.....	$5,000,000	$ 100	2½	Jan. '76	108½	110
" " Bonds	90,000	1,000	†3½	Feb. '76	106	110
NewYork, "	4,000,000		5	Jan. '76	139	141
Metropol. "	2,500,000	100	5	Mar. '76	145	145½
" " Certf.	1,000,000	....	3½	" "	102	104½
" " Bonds	500,000	1,000	3½	Jan. "	102	102½
Harlem "	1,850,000	50	4	Feb. '76	98	105
Manhattan"	4,000,000	50	10	July "	245	250
Brooklyn, B'klyn..	2,000,000	25	5	June '76	180	188
Nassau "	1,000,000	25	4	Jan. '76	75	80
" " Certf.	700,000	1,000	3½	Nov. '76	95	98
People's "	1,000,000	10	3½	Jan. '76	50	55
" " Certf.	300,000	1,000	3½	Jan. '76	85	90
" " Bds	325,000	....	3½	Feb. "		95
Metropol. "	1,000,000	10	3½	Nov. '75	75	77½
Wmsburgh "	1,000,000	50	5	Jan. '76	130	135
" " Certf.	1,000,000	....	3½	Jan. "	101	102½
Citizen's "	1,200,000	20	2½	Jan. '76	92½	93
" " Certf.	320,000	1,000	3½	April "	98	100
J. C. N.J.....	386,000	20	5	July,'75	100	—
Centl. Westch. N.Y.	466,000	50	4	July. "	95	—
Subur'n " "	390,000	50				95

† Gold.

Companies out of Town.—We refer to our last issue for the list of these.

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MINING STOCKS.

AMERICAN MINING BOARD'S LIST.

Name of Company.	Location.	Feet on Vein.	Capital Stock.	*a* No. of Shares.	Total Assessments Levied.	Date and Amount of Last Assessment per share.	Total Dividends paid.	Date and Amount of Last Dividend per sh.	Closing Quotations *g* American Currency. Sat.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sales for the Week.
Alpha Cons. G. S.....	Nevada,	300	$ 3,200,000	30,000	$180 000	Aug. 12, '75, $1.	....	.....	$48 25	....	....	....	....	$48 37½	250
Belcher, G. S.....	Nevada,	1,040	10,400,000	104,000	660,400	April 14, '71, $1.	$15,397,200	April 10, '76, $1.	....	....	....	$19 75	....	19 75	200
Best and Belcher, G. S.	Nevada,	545	10,080,000	100,800	136,192	July 13, '74, 50c.	....	.....	....	$52 00	....	....	44 00	....	150
Bullion, G. S.....	Nevada	943½	13,000,000	100,000	2,052,000	Sept. 22, '76, $2.50.	....	.....	....	....	....	....	....	....	...
Caledonia, G. S.....	Nevada,	2,188	10,000,000	100,000	1,210,000	Aug. 28, '76, $1.00.	....	.....	11 37½	11 62½	....	....	....	10 50	600
California, G. S.....	Nevada,	600	54,000,000	540,000	....	.....	5,400,000	Sept. 15, '76, $2.	67 37½	65 87½	....	64 00	....	65 50	260
Chollar Potosi, G. S....	Nevada,	1,400	2,800,000	28,000	1,282,000	June 26, '76, $5.	3,080,000	Feb. 10, '72, $1.	87 75	....	....	....	....	87 00	200
Cleveland, G.....	Colo.	3,715	250,000	25,000*b*	....	.....	....	.....	7 37½	7 37½	7 50½	7 25	7 37½	7 50	3,5 0
Cons. Imperial, G.S....	Nevada,	468	50,600,000	500,000	125 000	July 25, '76, 25c.	....	.....	4 87½	....	4 62½	4 50	4 12½	....	1,800
Cons Virginia, G S....	Nevada,	710	54,000,000	540'000	411,200	June 11, '73, $3.	22,680,000	Sept. 11, '76, $2.	62 12½	60 50	59 75	....	....	53 25 •	185
Confidence, G. S.....	Nevada,	130	2,496,000	24,962	243,840	March 18, '73, $1.	78,000	May 1, '65, $8.33⅓	17 00	....	....	....	....	....	100
Crown Point, G. S.....	Nevada,	600	10,000,000	100,000	1,073,370	Aug. 15, '76, $1.	11,588,000	Jan. 12, '75, $2.	12 00	....	....	12 12½	12 00	....	1100
Eureka Cons. G. S. L....	Nevada,	..	5,000,000	50,000	100,000	May 26, '76, $1.	1,000,000	Aug. 5, '75, $1.	....	....	....	....	....	....	.....
Exchequer, G. S.....	Nevada,	400	10,300,000	100,000	280,000	Sept. 22, '76, $1.	....	.....	15 00	....	....	....	15 00	15 75	1000
Gould and Curry, G. S.	Nevada,	621	10,800,000	108,000	2,018,000	Aug. 11, '76, $1.	3,826,800	Oct. 10, '70, $10.	....	....	16 25	....	....	15 50	300
Grant, G. S.....	Nevada,	1,000	10,000,000	100,000	....	.....	....	.....	3 87½	3 75	3 50½	3 50	3 37½	4 50	11,3 0
Hale & Norcross, G. S..	Nevada,	400	11 200,000	112,000	2,130,000	Aug. 8, '76, $1.	1,598,000	April 10, '71, $5.	....	....	....	8 12½	....	....	350
Hukill, S.....	Colo.	3,283	1,000,000	10,000	....	.....	10,000	$1	...	....	....	....	....	....	.....
Indian Queen, S.....	Nevada,	1,000	3 000,000	60,000	....	.....	60,000	.....	....	....	....	....	7 50	12 00	950
Julia Cons, G. S.....	Nevada,	3,000	11,030,000	110,000	110,000	Sept. 11, '76, $1.	....	.....	....	....	....	....	8 25	....	600
Justice, G. S	Nevada,	2,100	10,500,000	105,000	1,502,500	Sept. 14, '76, $5.	....	.....	19 50	19 75	....	19 12½	19 50	18 75	600
Kentuck, G.S.....	Nevada,	95	3,000,000	30,000	270,000	Dec. 3, '74, $1.	1,252,000	March 8, '70, $5.	.. ..	....	....	....	....	....	.....
Kossuth, G.S..	Nevada,	2,700	5,400,000	108,000*c*	405,000	Aug. 15, '76, 50c.	....	.....	....	....	....	....	....	....	.....
Leopard, G. S.....	Nevada,	1,500	5,000,000	50,000	50,000	March 31, '76, $1.	87,500	Feb. 15, '76, 75c.	....	....	....	....	10 37½	....	400
Mexican, G. S.....	Nevada,	600	10,080,000	100,800	100,800	Sept. 5, '76, 50c.	....	.....	....	....	....	....	....	....	...
Merrimac, S	Mass.	1,500	500,000	5,000	....	.....	....	.....	39 87½	39 50	40 00	40 25	40 00	39 50	1,275
Morning Star.....	Nevada,	1,600	8,000,000	80,000	....	.....	....	.....	....	....	....	....	....	....	.....
Northern Belle, S.....	Nevada,	1,600	5,000,000	50,000	....	.....	800,000	Sept. 15, '76, $1.	....	....	....	....	....	....	.....
Ophir, G. S.....	Nevada,	675	10,080,000	100,800	2,034,400	May 14, '75, $2.	1,394,400	March 9, '64, $4.	54 00	....	....	48 75	....	48 00	450
Overman, G. S.....	Nevada,	1,200	3,840,000	38,400	2,107,080	June 26, '76, $3.	....	.....	83 75	....	....	....	....	....	110
Pleasant View.....	Colo.	1,200	203,000	20,000'	....	.....	....	.....	....	3 62½	3 50	3 50	....	....	1,050
Raymond and Ely, G. S.	Nevada,	5,000	3,000,000	30,000	510,000	Nov. 5, '75, $3.	3,075,000	Sept. 10, '73, $3.	....	....	....	....	....	....	.....
Santiago, G. S.....	Nevada,	2,000	11,200,000	112,000	....	.....	....	.....	....	....	12 00	....	11 25	....	500
Savage, G.S	Nevada,	800	11,200,000	112,000	2,746,000	May 31, '76, $2.	4,460,000	June 11, '69, $3.	....	17 37½	....	....	....	13 25	700
Sec. Belcher, G.S.....	Nevada,	160	640,000	6,400	244,800	April 11, '76, $5.	....	.....	....	....	....	....	....	....	.....
Sierra Nevada, G. S...	Nevada,	3,650	10,000,000	100,000	1,400,000	Aug. 22, '76, $1.	102,500	Jan. 16, '71, $1.	13 00	15 00	....	12 50	....	....	900
Silver City, G. S.....	Nevada,	3,900	6,310,000	63,100	....	.....	....	.....	....	....	....	....	9 00	....	700
Silver Hill, G. S	Nevada,	5,400	10,800,000	108,000	810,000	Sept. 18, '76, $1.	....	.....	....	....	....	....	....	....	.....
South Comstock, G. S..	Nevada,	1,500	10,000,000	100,000	44,000	May 3, '76, 10c.	....	.....	....	....	....	....	....	....	.....
South. California, G. S.	Nevada,	1,500	5,000,000	50,000	....	.....	....	.....	....	....	....	....	....	....	.....
Trenton, G. S.....	Nevada,	..	10,000,000	100,000	....	.....	....	.....	....	....	....	35 00	....	....	.....
Union Cons. G. S.....	Nevada,	850	10,000,000	100,000	260,000	March 3, '76, $1.	....	.....	....	....	....	....	14 00	....	100
West Belcher, G. S....	Nevada,	1,000	10,000,000	100,000	....	.....	....	.....	....	....	....	....	....	....	.....
Yellow Jacket, G. S....	Nevada,	1,200	12,000,000	120,000	2,598,000	July 18, '76, $1.	2,184,000	Aug. 10, '71, $2.50.	37 12½	....	27 00	....	25 50	25 62½	1,350
Young America, S.....	Nevada,	1,020	3,000,000	30,000	....	.....	....	.....	....	....	....	....	....	....	.....

Total shares sold..... 31,020

BOSTON STOCK MARKET

									Fri.	Sat.	Mon.	Tues.	Wed.	Thurs.	
Allouez, C.....	Mich.	..	$1,000,000	20 000	$94c,000	May 9, '76, $5 p.sh	....	.....	$15 00	....	$15 00	....	....	$12 0	.....
Calumet and Hecla, C..	Mich.	2¾ mile	2,000,000	80,000*d*	1,200,000	.....	$10,650,000	Aug. 15, '76, $5 p.s	1 69	169 50	172 00	175 00	175 50	175 00	294
Central, C.....	Mich.	..	500,000	20,000*e*	100,000	June, '62, 65c.	1,020,000	Feb. 17, '76, $5.	34 00	35 00	35 00	35 00	35 00	34 00	.....
Copper Falls, C.....	Mich.	..	1,000,000	20,000*d*	535,000	May 10, '76,	100,000	Nov., '71, $1.	5 00	5 00	5 00	5 25	5 25	.....	100
Dana, C	Mich.	..	500,000	20,000*d*	68,000	Jan., '73, 50c.	....	.....	20 00	20 00	20 00	20 00	20 00	20 00	.....
Dawson Silver, S.....	Canada.	..	1,200,000	60,000*f*	....	.....	.. ..	.....	0 35	0 35	0 35	0 35	0 35	0 33	500
Duncan Silver, S.....	Canada.	..	1,200,000	60,000*f*	75,000	July, '76, 41½.	....	.....	11 87½	11 50	11 50	12 50	12 50	12 25	3,300
Franklin, C	Mich.	..	500,000	20,000*d*	360,000	June, '68, $5.	585,000	Nov., '71, $1.	0 15	0 14	0 14	0 14	0 14	0 14	400
Humboldt, C	Mich.	..	500,000	20,000*d*	100,000	Sept. 28, '76, 15c.	....	.....	10 00	9	10 00	10 00	10 00	10 00	.....
International Silver, S.	Canada.	..	1,200,000	60,000*f*	....	.....	....	.....	1 50	1 56¼	1 50	1 62½	1 50	0 94	5,220
Madisch, C.....	Mich.	..	50,000	20,000*d*	123,000	Sept. 11, '74, 10c.	....	.....	40 00	37 00	37 00	37 00	37 00	35 00	.....
Mesnard, C.....	Mich.	..	500,000	20,000*d*	160,000	April 12, '65, 50c.	....	.....	0 50	0 45	0 45	0 45	0 45	0 45	.....
Minnesota, C.....	Mich.	..	1,000,000	20,000*d*	436,000	June 10, '69, $1.	7,820,000	Mch. 15, '76, 50c.	2 00	2 00	2 00	2 25	2 25	2 00	.....
National, C.....	Mich.	..	500,000	20,000*d*	195,000	Oct., '75, $1 pr. sh	360,000	Oct., '73, $1.	2 25	2 50	2 50	2 50	2 50	2 25	450
Osceola, C	Mich.	..	1,000,000	40,000*d*	880,000	May 1, '76, $2.	....	.....	21 00	21 00	21 00	21 00	21 00	21 00	.....
Petherick, C.....	Mich.	..	500,000	20,000*d*	165,533	March 22, '76, 50c.	....	.....	62 00	65 00	62 00	58 00	62 00	70 00	.....
Pewabic, C.....	Mich.	..	500,000	20,000*d*	185,000	June, '68, $5.	460,000	July, '73, $1.	5 00	5 00	5 00	5 00	5 00	140 00	.....
Phenix, C.....	Mich.	..	1,000,000	20,000*d*	817,500	Sept., '70, $3.	....	.....	13 50	14 00	14 00	14 00	14 00	15 00	.....
Quincy, C.....	Mich.	..	h 200,000	20,000*b*	....	.....	2,050,000	Oct. 28, '76, $3.	46 75	47 00	47 50	48 50	48 50	49 00	52
Ridge, C.....	Mich.	..	500,000	20,000*d*	....	.....	....	.....	...	6 00	6 00	6 00	6 25	6 25	.....
Rockland, C.....	Mich.	..	500,000	20,000*d*	495,000	Jan., '74, $1 pr. sh.	....	.....	0 50	0 50	0 50	0 50	0 50	0 45	.....
Star, C.....	Mich.	..	500,000	20,000*d*	265,000	March 30, '76, 50c.	....	.....	0 45	0 50	0 50	0 50	0 50	0 43	.....
Superior, C.....	Mich.	..	500,000	20,000*d*	340,000	March, '74, 25c.	....	.....	0 20	0 20	0 20	0 20	0 20	0 20	.....

Total Shares sold..... 10,316

c. Gold, s. Silver, L. Lead. C. Copper. *a* The par value of shares is $100, unless otherwise designated. *b* The par value of these shares are $10 each. *c* The par value of these shares $50 each. *g* Closing quotations represent the latest prices bid. Prices asked will have a * affixed.
d The par value of these shares are $25 each. *e* The par value of these shares are $15 each. *f* The par value of these shares are $20 each. *h* Full paid. *i* On the four old companies